SCIENTIFIC AMERICAN

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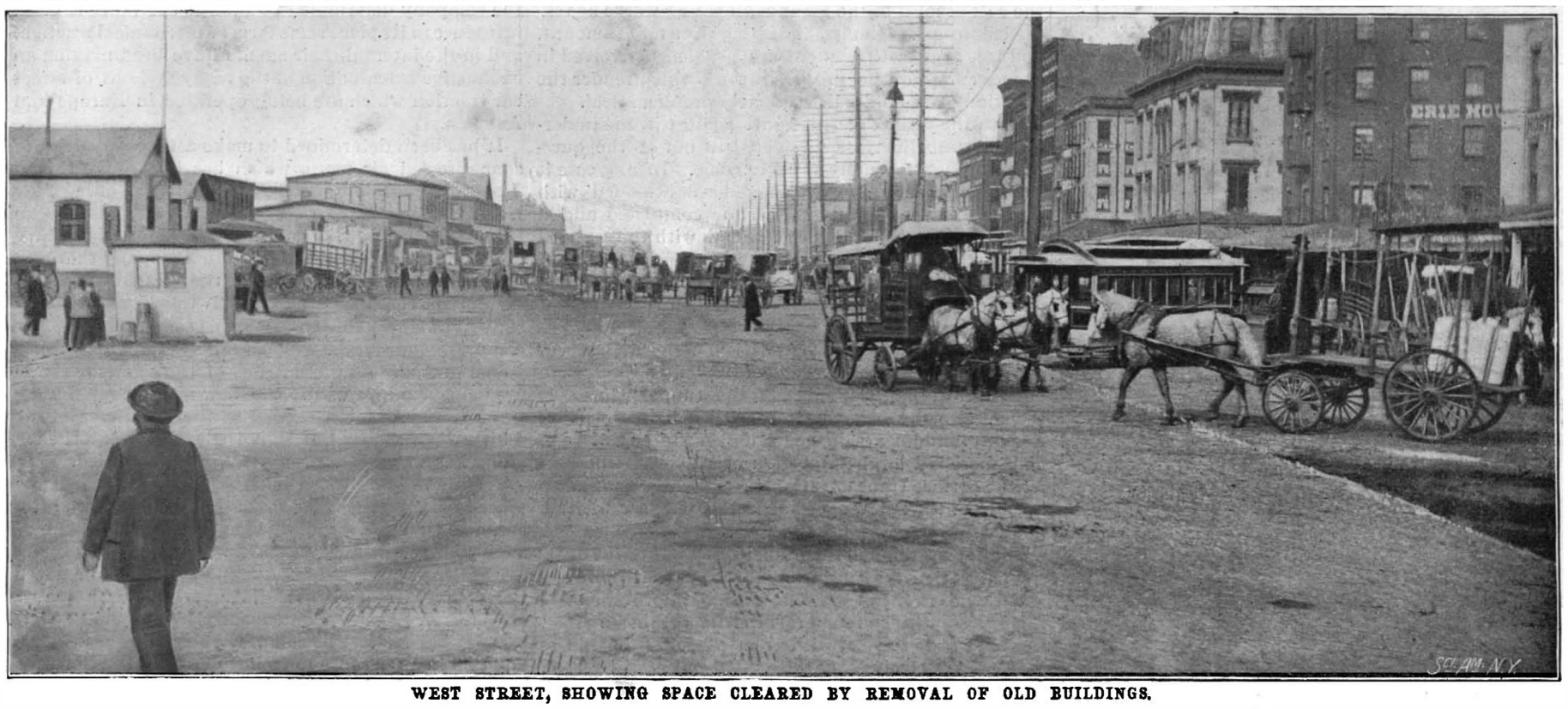

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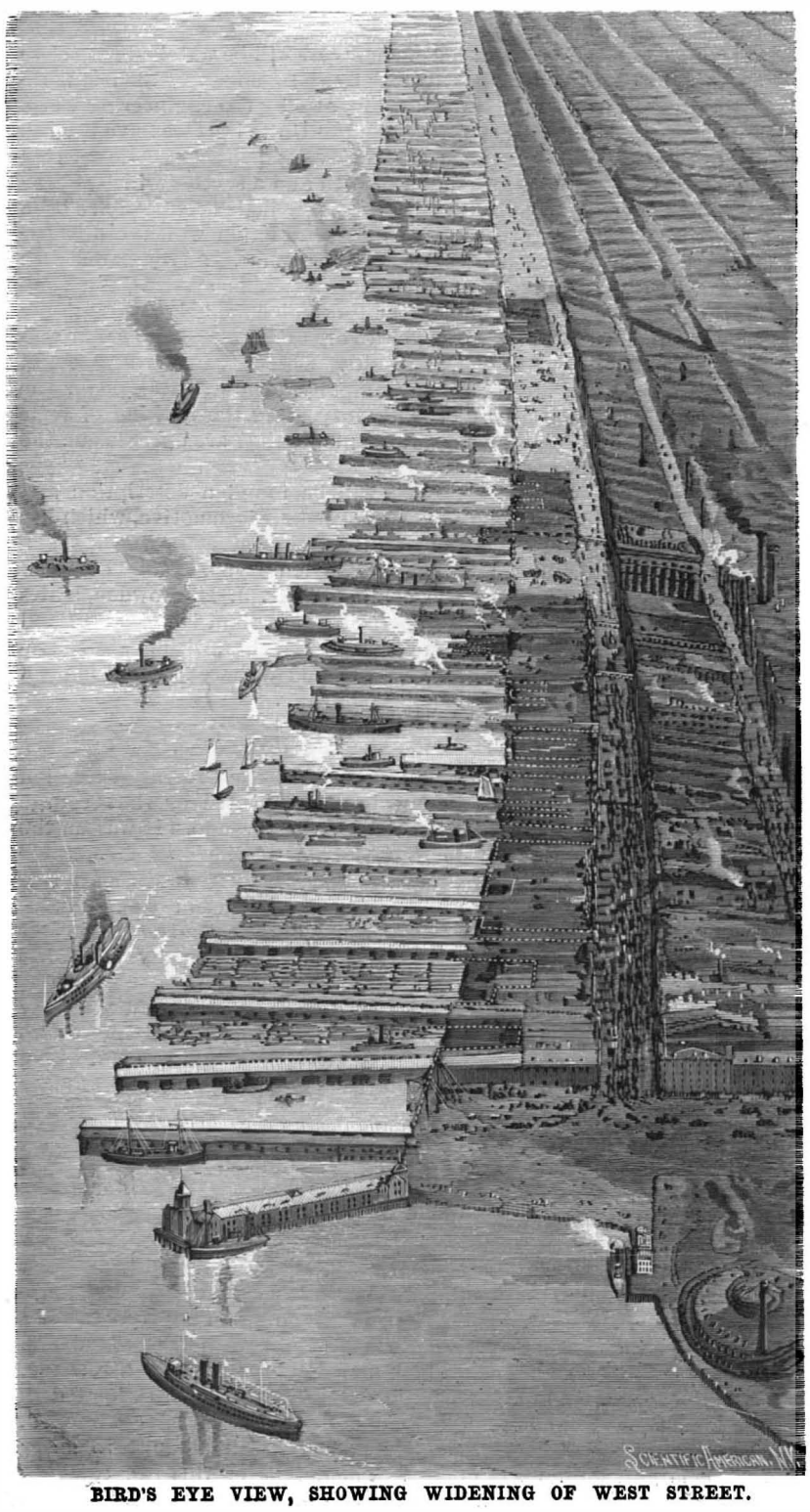
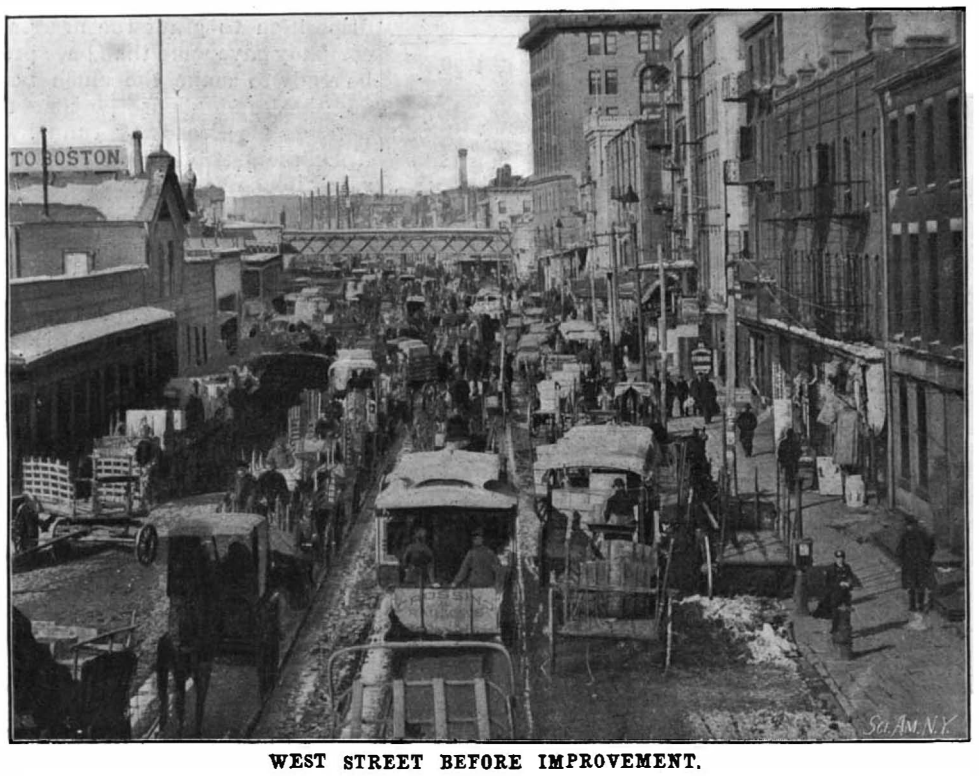


BIRD'S EYE VIEW, SHOWING WIDENING OF WEST STREET.



WEST STREET BEFORE IMPROVEMENT.

DREDGING OUT SLIPS.

THE WIDENING OF WEST STREET AND ALTERATION OF THE DOCKS ON HUDSON RIVER FRONT, NEW YORK.—[See page 360.]

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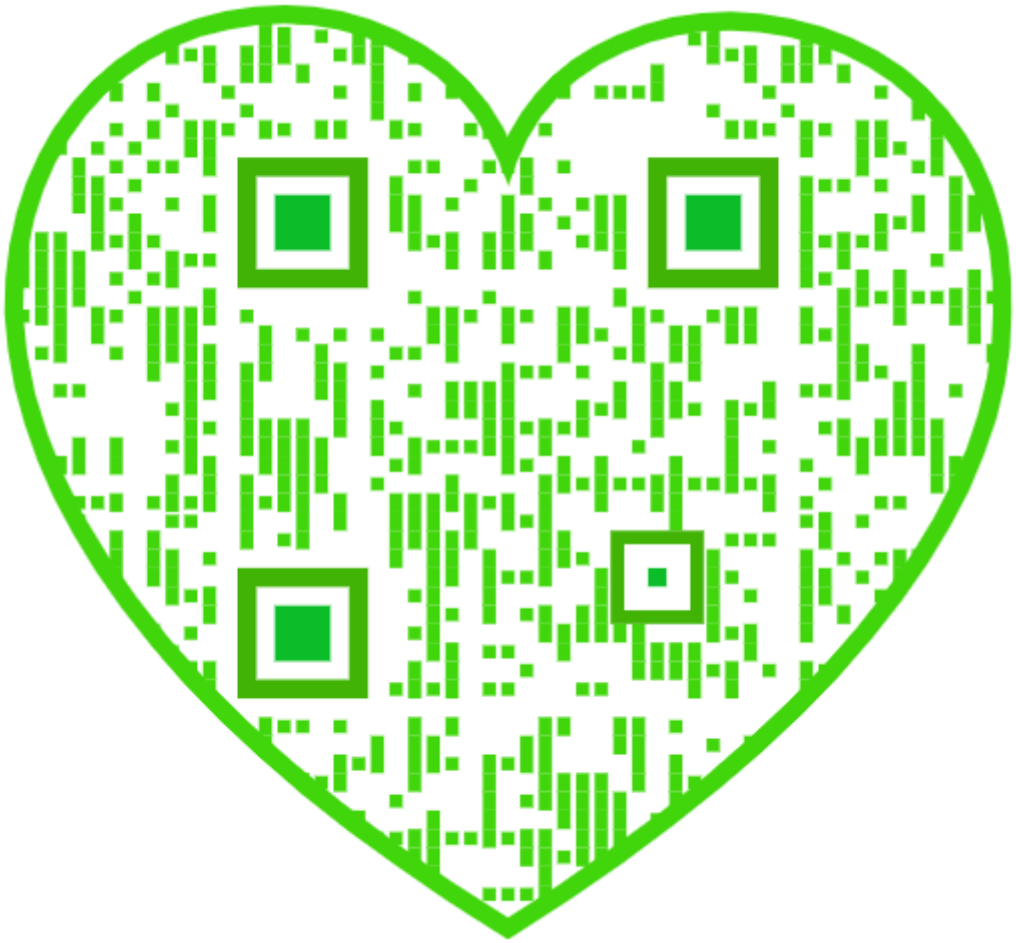

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THE ELEVATED ROADS AND THE RAPID TRANSIT PROBLEM.

The judgment of the Appellate Justices upon the late proposal of the Rapid Transit Commission should be read by every citizen who is interested in the subject of increased transit facilities. It judges the question from a broad standpoint, and shows a conservative regard for the permanent interests of the city. The court points out that the scheme, as presented for its judgment, was very incomplete, and that the data upon which the estimates were based was insufficient to give them any reliable value. It is pointed out that the cost of most of the great engineering works has exceeded the first estimate, and always by a large amount, and it is argued that there are problems involved in the execution of the proposed work which render the question of its final cost extremely problematical.

With the verdict of this court against it, the underground tunnel may be considered as out of the question, at least for many years to come. In any case it was a scheme which would have been attended with serious drawbacks; and were it now completed and in operation, it would have to contend with the natural repugnance of the people to descending a flight of stairs and burying themselves in an artificially lighted and more or less imperfectly ventilated tunnel for a quarter or half an hour as the case might be. It is quite a question as to whether the light and air of surface travel would not be considered to more than outweigh the superior speed of the tunnel route. It is a noteworthy fact that although a belt system of underground lines is in operation in the city of London, there is a large proportion of travelers who prefer the surface transportation in cabs and omnibuses in spite of their slow speed of from five to six miles an hour.

The construction of the tunnel being out of the question, attention will naturally be directed to the elevated roads; for in the extension and improvement of this system is to be found an alternative scheme which would provide the city with greatly improved facilities at a comparatively early date. We have good reason to believe that these roads would have been extended and improved before this if the city had shown any disposition to grant the necessary permission. The company have more than once professed themselves to be ready to make the much needed alterations and additions, and about the time that the question of building the Broadway tunnel was submitted to the Appellate Justices, the officers of the Manhattan Elevated Roads again manifested a commendable desire to meet the convenience of the public by extending their system and quickening their service. Certain plans and promises were made to the mayor of the city, all of which would seem to indicate that the company was desirous to make a reasonable provision for the needs of the 200,000,000 passengers who annually serve to swell the dividends of this very successful monopoly. It was not suggested that the proposed extension was to be made in any way dependent upon the rejection of the Broadway tunnel scheme; and a proposed outlay which was considered expedient in the face of a powerful competitive scheme must be doubly expedient now that this scheme has fallen through.

If the officers of the elevated roads are sincere in their expressed desire to extend their system, the next and immediate step should be to place their proposal before the Rapid Transit Commission—a commission that was created for the express purpose of receiving such suggestions. If there is any doubt as to the legal status of the commission, there are other means by which the proposals of the company can be made known to the citizens and passed upon by them.

The matter is an urgent one, and there can be no possible excuse for a lengthy delay upon the part of the company. On the other hand, any proposals that may be offered should be judged with the sole object in view of the city's best interests. If the elevated roads have been enormously profitable, they have also been enormously useful; and if their recent overtures through the mayor have been made, as we believe, in good faith, they should be at once accepted and the company given every opportunity to carry out the extension.

If, however, the elevated roads should make no further move looking to extension of their system, the city should use the strong arm of the Legislature in its behalf. The case is too serious to admit of delay. The volume of travel is steadily increasing and already in some quarters it fairly swamps the accommodation provided for it. Many of the terminal stations are nightly filled with a struggling mob, in which the commonest laws of chivalry seem for the nonce to be forgotten, and strong men elbow frail women in the wild rush to secure the much coveted seat—and this in the representative city of what should be, and in most regards is, the most progressive country and people in the world!

A FOSSIL bird, represented by a piece of a bone from a bed of clay on Vancouver Island, is described by Cope, who thinks that it may have been "the largest bird of flight thus far known."

PROPOSED EQUIPMENT OF THE NEW YORK SURFACE ROADS WITH COMPRESSED AIR MOTORS.

The Metropolitan Traction Company, which controls altogether about 132 miles of street railway in this city, and carries daily upward of 650,000 passengers, is contemplating an important change in the motive power of a large portion of its lines. About 32 miles of the system are at present operated as cable and underground trolley lines, and the plant is of the latest pattern and thoroughly up to date; but the greater part—fully 100 miles of the lines—is still worked by the slow and objectionable horse car. Several months ago the company determined to abolish the horse car and introduce in its place some form of mechanical traction, and in the interval their agents have been making an exhaustive examination of the many systems of street car traction which are being operated in Europe and America.

It has been determined to make a thorough trial of a compressed air motor which has been designed by Joseph H. Hoadley, of the engineering firm of Hoadley Brothers, who is now associated with the American Wheelock Engine Company, of Worcester, Mass. We are informed by the Metropolitan Company that at a private trial recently had at the Worcester works before the engineers and officials the Hoadley motor showed a remarkable efficiency, as compared with any compressed air motor which they had previously subjected to trial. At present ten of the company's cars are being equipped with the new motor, and if they prove as successful in service as the experimental car which was recently tested, it is likely that all the existing horse car roads will be similarly equipped.

The air will be carried in two cylindrical steel tanks placed between the trucks and beneath the floor of the car, and they will be charged at an initial pressure of 2,000 pounds to the square inch. The power house at 147th Street and Lenox Avenue will contain a 500 horse power Greene-Wheelock engine and a Minerva air compressor, the reservoir capacity of the plant being 5,000 cubic feet. The compressed air motor is being adopted in preference to trolley or cable traction, not merely from motives of economy, but also with a view to securing a service which shall be free from the interruptions to which the cable and trolley systems are liable.

The operation of these cars will be watched with close attention, not merely by the company which is making the experiment, but also by the engineering world at large. Engineers in the United States have been so fully occupied with the development of electric traction—and it has had a growth and a success which is phenomenal—that comparatively little attention has been paid to other methods of traction which utilize the oil, gas, and compressed air motor. As compared with the cost of the electric and cable systems, the compressed air and gas motors which are being increasingly used in European cities are said to be showing remarkably economical results. Chief Engineer Pearson, of the Metropolitan Company, is now in Europe for the purpose of personally inspecting the working of some of the more important plants that are operated on the above systems.

On another page will be found a description and illustrations of a compressed air locomotive, which has proved very successful in the mines of the Susquehanna Coal Company, Glen Lyon, Pa. The chief engineer of the company, Mr. J. H. Bowden, states that the cost of operating this plant is between 1 and 1½ cents per ton per mile, and that, with the introduction of a better type of coal car, he expects to make a still more economical showing.

The St. Louis Disaster.

For the second time within the present generation the city of St. Louis has been visited by that scourge of the Mississippi Valley, the tornado. It was on the evening of March 8, 1872, that the ever memorable cyclone carried death and destruction through this ill-fated city; and to-day the citizens are again occupied in the sad task of burying the dead and caring for the wounded that have been smitten by this worst form of nature's savagery.

The full cyclonic force of the storm of Wednesday evening was not felt at the outset, but appears to have been preceded by a violent wind storm, which swept over the whole city at the rate of eighty miles an hour. This was succeeded by a heavy deluge of rain, in the midst of which the cylone developed in the southwestern suburbs and cut a wide swath of destruction through the city. Crossing the Mississippi in the neighborhood of the Eads Bridge, the upper works of which were badly wrecked, it laid low a large part of East St. Louis, and demolished a vast amount of shipping and also a long stretch of warehouse property that was standing on the river front.

The destruction was wrought with that speed and completeness which marks the passage of a tornado, and in a few minutes some 400 to 500 are estimated to have been killed outright and over 1,500 wounded, while the damage to property will amount to many millions of dollars. The details of this sad calamity are too well known to call for any repetition. Beyond

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the fact that the whole of Wednesday had been oppressively hot and the air heavy and stifling, there were no premonitary signs of the impending disaster. There is food for thought in the fact that, with all our advancement in science and our boasted intimacy with the laws of nature, there are phenomena such as this, which are known to us only by their death-dealing fury, whose approach we cannot even predict and in whose presence we are utterly helpless.

Recent Patent and Trade Mark Decisions.

Dadirrian v. Yacubian (U. S. C. C. Ill., Showalter C. J.) 72 Fed. Rep. 1010.

A Foreign Common Noun as a Trade Mark.—The word "Matzoon" has been in use in Armenia for centuries as the name of an article of food made of fermented milk. A person manufacturing such article in the United States cannot monopolize the Armenian name of the article as his trade mark. The fact that it is a word unknown in the United States is immaterial so long as it is the generally recognized name of the article whereby it is known.

Thomson-Houston Company v. Electric Railway Electric Company (U. S. C. C. Conn., Townsend J.) 72 Fed. Rep. 1016.

Contributory Infringement.—Contributory infringement is the intentional aiding of one person by another in the unlawful making or selling or using of a patented invention. In this case the patent was for a trolley system and the defendants sold trolley stands for the purpose of being used in such trolley system and as a part thereof, and hence the defendants were held to be guilty of contributory infringement of a patent and were enjoined from such infringement.

Cook & Bernheimer Company v. Ross (U. S. C. C. N. Y., Lacombe J.) 73 Fed. Rep. 203.

Unfair Competition.—The plaintiff bottled whisky in bottles of a peculiar shape originally devised by him, and by extensive advertising such bottles came to be relied upon by purchasers as a means of identifying the whisky bottled by him. Afterward the defendant, dealing in the same whisky, began to use a bottle of precisely similar shape and appearance as that of the plaintiff, although the labels used were different. It was held that the use of such bottles by the defendant was unfair competition and should be restrained.

Bonsack Machine Company v. Underwood (U. S. C. C. N. C., Seymour J.) 73 Fed. Rep. 206.

Cigarette Machines.—The Hook patent, No. 184,207, for a cigarette making machine is a primary patent and is infringed by the device shown in the Underwood patent, No. 470,269.

Infringement by Experimental Machines.—The making of an experimental machine like a patented machine is not an infringement, but if it is to be used for selling the patent under which it is made, it ceases to be merely an experimental machine and a suit will lie for infringement.

License to Make Infringing Machine.—A manufacturer contracted with a corporation to make no cigarette machines excepting under the corporation's patent. However, he afterward submitted to its secretary the question of making the machine for another inventor and was told to go ahead and that the company would look into the matter of infringement when the machine was put on the market. It was held that this did not prevent the company from suing the inventor for infringement.

Matthew & Willard Manufacturing Company v. Trenton Lamp Company (U. S. C. C. N. J., Greene J.) 73 Fed. Rep. 212.

Infringement Suit Against Officers of a Corporation.—In a suit against a corporation for infringement of a patent it is neither necessary nor proper to make the officers of the company, who are mere salaried employes not dependent upon the sale of the alleged infringing article and who have not personally been guilty of infringement, parties defendant to the suit.

Who are Entitled to Design Patents.—The law authorizes the issuance of a design patent to any person who "by his own industry, genius, effort and expense has invented" the design. In this, the word "expense" is not limited to mere disbursement of money, and hence does not prevent the granting of a patent to one who invents a design while in the employment of another, especially where it does not appear that "expense" was necessary in producing the design.

Lamps.—The design patents to Miller, Nos. 22,422, 23,672, 23 673, and to Miller & Schmitz, No. 23,671, have been held valid.

Palmer Pneumatic Tire Company v. Newton Rubber Works (U. S. C. C. W. Va., Goff C. J.) 73 Fed. Rep. 218.

Preliminary Injunctions.—It is held in this case that the patent alone will not create a sufficiently strong presumption of its own validity to justify the granting of a preliminary injunction against its infringement. There must be either a prior adjudication sustaining the patent or a continuous acquiescence for a considerable period of time or it must have withstood an interference contest in the Patent Office.

Proof of Public Acquiescence in the Validity of a Patent.—Where public acquiescence in the validity of a patent is not alleged in the bill of complaint, it is insufficient to allege universal acquiescence by mere statements in affidavits, and when such affidavits are controverted by a number of witnesses giving names, dates, and showing that for nearly two years before several manufacturers had been making and selling goods substantially similar to those covered by the patent, public acquiescence is not proved and a preliminary injunction will not be granted.

Parker v Appert (Ct. of Appeals D. C.) 75 O.G. 1201.

Amending Preliminary Statement.—It is always a suspicious circumstance in the case of interference that after the dates of one of the parties have been disclosed that the other party should then seek by amendment of his preliminary statement to show a date of invention prior to that of his original statement and prior to that of his opponent.

Dates of Sketches.—Where a party to an interference states that he made the sketches upon which he relies for the establishment of his earlier date but mislaid them and forgot where they were until after the disclosure of the dates of the other party, the matter is suspicious and the amendment to his preliminary statement should not have been allowed.

The Old World's Old Folks.

A German statistician has studied the census returns of Europe to learn a few things about the centenarians of the Old World. He has found, for instance, that high civilization does not favor the greatest length of life. The German empire, with 55,000,000 population, has but 78 subjects who are more than 100 years old. France, with fewer than 40,000,000, has 213 persons who have passed their hundredth birthdays. England has 146; Ireland, 578; Scotland, 46; Denmark, 2; Belgium, 5; Sweden, 10; and Norway, with 2,000,000 inhabitants, 23. Switzerland does not boast a single centenarian, but Spain, with about 18,000,000 population, has 401.

The most amazing figures found by the German statistician, says the New York Sun, came from that troublesome and turbulent region known as the Balkan Peninsula. Servia has 575 persons who are more than 100 years old; Roumania, 1,084; and Bulgaria, 3,883. In other words, Bulgaria has a centenarian to every thousand inhabitants, and thus holds the international record for old inhabitants. In 1892 alone there died in Bulgaria 350 persons of more than 100 years. In the Balkan Peninsula, moreover, a person is not regarded as on the verge of the grave the moment he becomes a centenarian. For instance, in Servia, there were in 1890 some 290 persons between 106 and 115 years, 123 between 115 and 125, and 18 between 126 and 135. Three were between 135 and 140.

Who is the oldest person in the world? The German statistician does not credit the recent story about a Russian 160 years old. Russia has no census, he says, and except in cases of special official investigation the figures of ages in Russia must be mistrusted. The oldest man in the world is then, in his opinion, Bruno Cotrim, a negro born in Africa and now resident in Rio Janeiro. Cotrim is 150 years old. Next to him comes probably a retired Moscow cabman, named Kustrim, who is in his 140th year. The statistician says the oldest woman in the world is 130 years old, but neglects to give her name or address, possibly out of courtesy, or perhaps in view of the extraordinary figures which came to his hand from the Balkans, he thought a subject only 130 years old was hardly worthy of particular mention.

The Boiling Point of Hydrogen.

If liquid air produced by the Linde process, according to the Journal of Gas Lighting, is to be a common article of commerce in the immediate future, liquid hydrogen is still sufficiently novel to attract the attention of the man of pure science. Professor Olszewski has recently determined the boiling point and the critical temperature of hydrogen; and the result shows that it is possible, by taking proper precautions, to do experimental work in the domain of physics at a point very near the absolute zero of temperature. The process is described in detail in Wiedemann's Annalen. The method of expansion, which had already been successfully employed to ascertain the critical pressure, was again utilized. The critical temperature is that at which liquid hydrogen, when slowly released from pressure, first boils up; and the boiling point is the temperature reached when the pressure is reduced to that of one atmosphere. The chief difficulty in these experiments is the thermometric one; and Professor Olszewski successfully overcame this by the employment of a thin platinum wire immersed in the liquid hydrogen, which by its varying resistance indicated the fall of the temperature. It is interesting to note, in connection with what has been stated with regard to the effect of cold upon the strength of materials, that Professor Olszewski used cast iron cylinders brought down to a temperature of 210° C. (not far from absolute zero) by means of liquid oxygen, at which the cylinders still held oxygen compressed to 18 atmospheres. The critical temperature of the hydrogen was, however, still lower, and was not reached until —234·5° C. had been registered. The boiling point was —243·5° C., or —406·3° Fah. (probably the greatest cold ever attained by artificial means).—Progressive Age.

The Huzulen.

In the Carpathian Mountains of Galicia dwells a primitive Salvic people called the Huzulen, which is nominally Roman Catholic and of whose curious customs Nature gives an account. Everywhere one comes across wooden crosses erected over buried brandy bottles. In 1894 a "brandy prophet" appeared; he was a simple peasant who waged a successful warfare against brandy drinking. The zeal of the people constrained the clergy to bury the spirit with ceremonies; and now the use of brandy has ceased, and at present only those drink brandy who are worth nothing. A gypsy, who had sent his wife away, bought the daughter of a Huzulen for fifty florins; he was reproved by the magistrate, but that had no effect. In a year he was tired of her, and then he hired the wife of another Huzulen for sixty florins; again the law was powerless, and at the end of the year the husband came for his wife. There are two remedies for backache—one is for the priest to walk on the patient's back in church and the other is to let a bear walk on it. Weasels, snakes, frogs, puppies, and kittens may not be killed, and there are numerous charms against the first two. For three days before the Huzulen moves into a new house he throws a black hen on it, so that snakes may not nest there. Black cattle are lucky. The mentioning of certain words for simmering and boiling is prohibited when applied to milk, lest harm should come to the cows. The grave diggers and coffin makers wash their hands over a grave to signify that they are not to blame for the sorrow, and the relatives ask the latter not to be angry with the dead for the trouble he has caused them, and not to ask for payment from him in the next world.

Role of Fats in the Animal Body.

The teachings of the most recent researches on this disputed question are summarized, says the Literary Digest, in a brief notice in Der Stein der Weisen.

"In the processes that go on in the body three groups of carbon compounds undergo a combustion in the true sense of the word—albumens, carbohydrates, and fats. Regarding the different functions of these materials, only this much is certain: that albumen is indispensable to the building up of new cells and the repair of waste material, and that carbon compounds, free from nitrogen, serve as fuel for the production of heat and mechanical work. These compounds consist of carbohydrates and fats and very probably of albumens also. It can also scarcely be doubted that the animal body can avail itself not only of fat but also of carbohydrates as fuel; but it is also to be assumed that in the normal physiological conditions fat and the carbohydrates play different roles. It should be noted that Nature herself has given to the infant in milk—without doubt an absolutely appropriate means of nourishment—not only albumen, but fat and carbohydrates. In most kinds of animals, especially in man, the proportion of sugar in milk is greater than that of fat, while on the other hand Dr. Gurdy of St. Andrew's has found in whale's milk the enormous amount of forty per cent of fat.

"The general opinion is this, that the strength-producing fuel in muscle is one of the compounds belonging to the carbohydrate group, glycogen or some similar compound, by whose combustion, together with the production of work, some heat is also inevitably produced. In ordinary circumstances this suffices to raise the bodily temperature to its normal height. But if this cannot be reached thus, other substances must be used as fuel. Heat produced by muscular work in the animal body is best obtained from the carbohydrates of the food, but besides this the indispensable production of heat is best attained through fats. This corresponds with the instinctive choice of foods made by men, who in the tropics eat little fat, while the dweller in polar regions devours large quantities of it to feed his bodily combustion.

"Moderate use of alcohol causes a deposit of fat, because, while alcohol is not turned into a fuel in the muscle and nerve cells, it serves as a pure fuel in the organism and replaces the combustion of fat. The reason that the use of alcohol is so dangerous in the polar regions is that alcohol favors the throwing off of heat in great degree, so that the effect is as if the stove in a room should be heated red hot and then all the doors and windows should be thrown open."

ROENTGEN photography is being successfully applied to biological studies. The ordinary star fish was photographed at the Durham College of Science and the contents of the caecum were found to be small shells both whole and broken; the stomach was filled with a whole common mussel. This interesting radiagraph is published in Nature.

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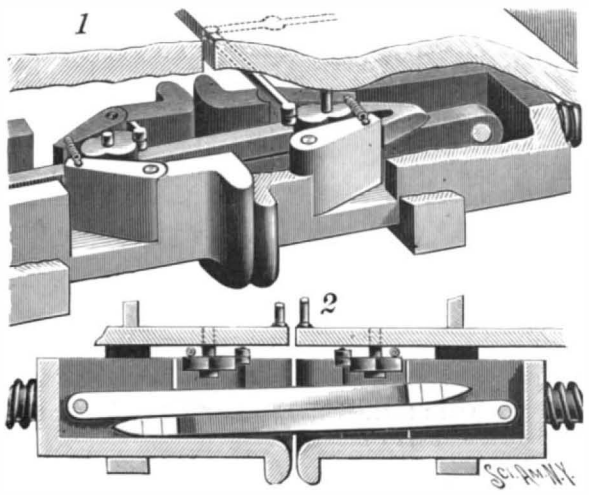
AN AUTOMATIC CAR COUPLER.

The automatic car coupler shown in the illustration has been patented by Mr. Peter Gallien, of New Haven, Connecticut, and Edward M. Clark of the same place. The drawhead is made open at the top, and in each of the side walls of the coupling chamber is placed a stout latch which is pivoted at its forward end, the free ends of the latches being drawn together by a coil spring. The drawhead coupling bar is horizontally pivoted at the rear end of the coupling chamber, and extends some distance beyond the front face of the drawhead, terminating in an arrow-shaped head. The head is perforated to receive a coupling pin when the improved drawhead is to be coupled with a link and pin coupler. The top and bottom faces of the coupling bar head are inclined so as to form a sharp horizontal edge. A cam is located between the opposing latches, and actuated by a link and rocking lever, which may be suitably operated from the platform of the car. In its normal position the longer axis of the cam is parallel with the



GALLIEN'S AUTOMATIC CAR COUPLER.

axis of the drawhead; but when it is desired to unlock the coupling, the cam is thrown over and forces apart the latches, thereby releasing the drawbar. In making a coupling, one coupling bar will ride upon the other as shown in the illustration, and the wedge-shaped heads will force apart the side latches, said latches being ultimately drawn snugly into place behind the recessed shoulders of the drawbar head by the tension of the spring, thus effecting an automatic and positive coupling.

A DOUBLE TANK COMPRESSED AIR MINE LOCOMOTIVE.

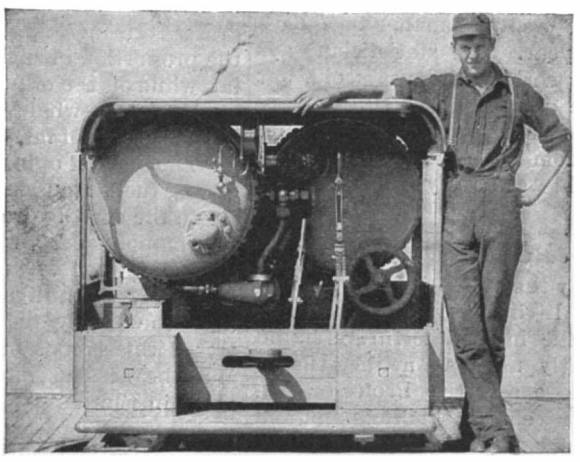
The compressed air locomotive has a special field of usefulness in locations where it is necessary to take extra precautions against risk of fire, such, for instance, as powder mills and lumber yards and the great cotton wharves and warehouses of the South, or those coal mines which are infested with dangerous gases. In this respect it is greatly superior to the steam, or even the electric, locomotive; and, as compared with rope haulage, it has the advantage that it has greater mobility, and can be run independently over a wide area of sidings, etc.

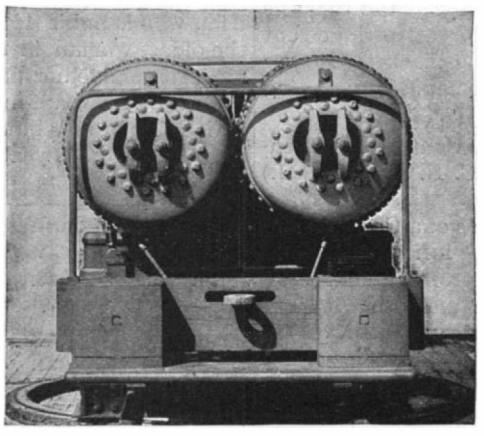
The accompanying illustrations show a double tank compressed air mine locomotive, built by H. K. Porter & Company, Pittsburg, Pa., for the Susquehanna Coal Company, Glen Lyon, Pa. The dimensions are as follows: Cylinders, 7 inches diameter by 14 inches stroke; driving wheels, four-coupled, 24 inches diameter; weight, in running order, 18,500 pounds; length over all, 17 feet 6 inches; width, 5 feet 2 inches; height, 5 feet. There are two tanks of 130 cubic feet combined capacity, and the charging pressure for doing full work is 600 pounds. The air for charging the locomotive is furnished by a three stage compressor, having 20 by 24 inch steam cylinders, with compression cylinders 12½ inches, 9½ inches and 5 inches diameter by 24 inches stroke, with a capacity of 275 cubic feet of free air per minute compressed to 600 pounds per square inch at 100 revolutions per minute. This capacity is more than sufficient for two locomotives. When supplying one locomotive the average speed of the compressor is about 40 revolutions per minute. The air is conveyed in a 5 inch wrought iron pipe to the bottom of the shaft, a distance of 1,000 feet, and a further 3,400 feet along the gangway. Along the gangway are three charging stations, provided with gate valves, which enable any section to be cut off. The 5 inch pipe, which has been tested to 1,500 pounds pressure, acts as a reservoir to the compressor, having a capacity of 580 cubic feet at 600 pounds pressure. The charging station consists of a cast tee on the main pipe, with a 1½ inch opening, provided with a gate valve and a flexible metallic joint. It takes one and one-half minutes to charge the locomotive, the pressure in the main being thereby reduced from 600 to 570 pounds.

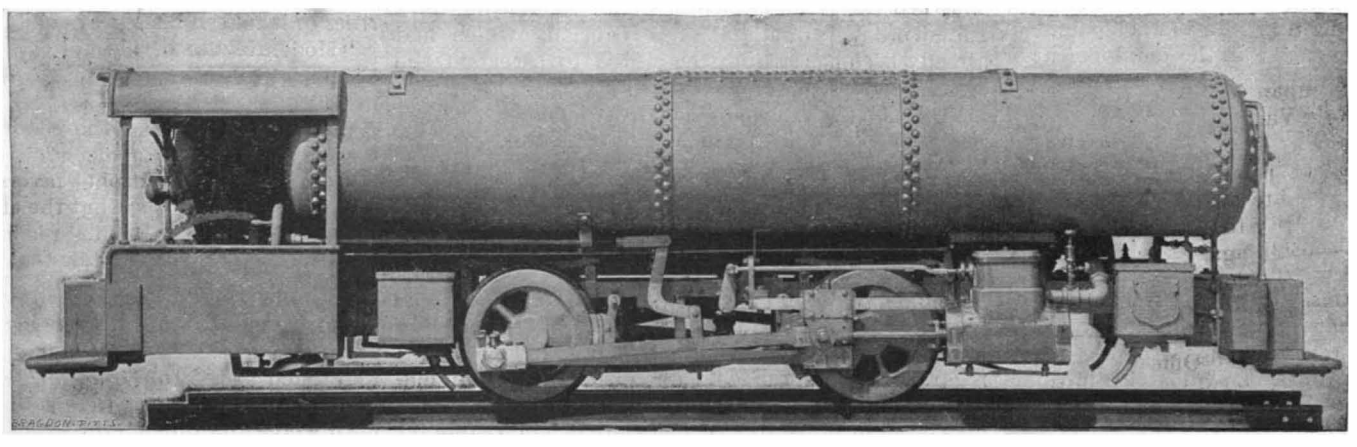
The air is stored in two steel tanks which are located between the locomotive cylinders on a saddle, much after the manner of a steam boiler. From them it is conducted to an auxiliary reservoir, eight inches in diameter, placed below and between them. In this tank the pressure can be regulated anywhere from 30 up to 140 or 150 pounds as required. The air is reduced from the main tanks by a reducing valve which can be regulated to any pressure at a moment's notice, and when once set, it maintains a constant fixed pressure in the auxiliary reservoir, thereby preventing any undue waste of air by injudicious handling. In case only light loads are to be handled, the pressure can be materially reduced in the auxiliary reservoir, or, on the other hand, in emergencies almost any pressure can be at a moment's notice utilized, and this without any undue heating or loss. In the auxiliary reservoir the air is controlled by a differential throttle, admitting the air to the cylinders.

The gage of the track is 36 inches, and the average grade is 1·07 per cent and the maximum grade 2·8 per cent in favor of the loaded cars. The locomotive hauls trips of 16 empty cars of about 2,500 pounds weight from the foot of the shaft, 3,700 feet, into the gangway, and trips of 16 loaded cars each with about 6,700 pounds of coal back to the shaft, with one charge of air, starting with a pressure of 575 pounds and ending with a little over 100 pounds. The heaviest work is hauling the empty trip up grade. The weight of each empty trip of 16 cars, including the locomotive, is about 60,000 pounds, and of the loaded trip, including the locomotive, 166,000 pounds. The locomotive will make from 25 to 50 miles per day, depending on the length of the run and the time required for making up trips.

The cost of operation of this plant has been found to vary from one to one and one-half cents per ton mile, including all expenses, interest and depreciation of plant, varying with the character of the rolling stock used. The depreciation on the locomotive is very low, there being no boiler to wear out; and the tanks, having nothing to corrode them, should, if kept well painted, last almost an indefinite period. In this case the condition of the car wheels, owing to spragging, was bad, there being many flat spots caused by sliding, and the frictional resistance per ton on the track was excessive. These cars are gradually being equipped with self-oiling wheels and a better form of brake. When this change is completed, it is expected that the cost of haulage by this system will be still further reduced.



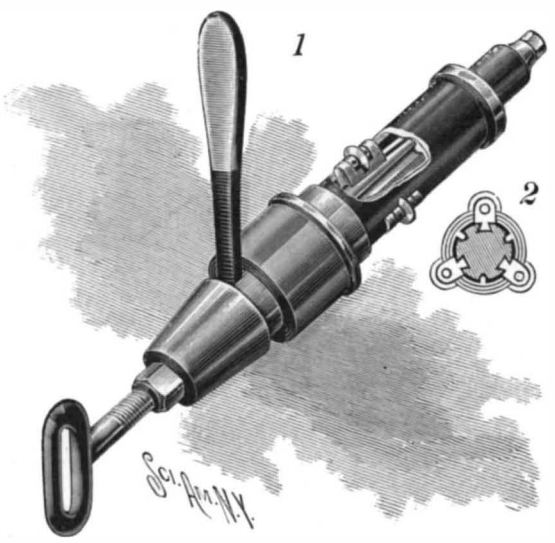




A DOUBLE TANK COMPRESSED AIR MINE LOCOMOTIVE.

A TUBE AND FLUE CUTTER.

An improved tube and flue cutter, which is simple and durable in construction, and arranged for cutting flues and tubes of different diameters, has been patented by Mr. Anton Kranzer, of Lidgerwood, North Dakota. By reference to the accompanying illustration it will be seen to consist of a central tapered mandrel, provided with disk cutters which are held in longitudinal dovetailed grooves in said mandrel, and an outer casing provided with suitable openings,



KRANZER'S TUBE AND FLUE CUTTER.

through which said disks project and in which they are adjustably held. To prevent the mandrel from rotating independently of the casing, it is provided with longitudinal grooves which are engaged by corresponding guide strips formed on the inner face of said casing. The upper end of the mandrel is engaged by a feed screw rod which works in the head of the end covering cap. By this means the mandrel is caused to travel in the direction of the axis of the machine, and the cutters are given a lateral motion, their cutting radius being enlarged or decreased as desired. To accommodate the various sizes of tubes, the tool is provided with extra casing tubes which have apertures corresponding to those provided in the main casing, and which can be fitted on over the same. To hold these casing tubes in place an end collar and a cap are provided, and a flanged collar is also slipped on over the opposite ends of the casings, said flange engaging the outer edge of the tube or flue which is to be cut. The tool is rotated by means of a crank arm and ratchet gear. When a tube is to be cut an end collar and a flange collar with casings corresponding to the size of the tube are put on the inner casing and the tool is passed into the tube. The mandrel is driven forward, forcing out the cutters against the tube and the tool is then rotated, the operation being continued until the tube is cut through.

At a meeting of the fellows of the Royal Botanic Society, in London, on March 28, it was stated, says Science, that since the gardens have been open to the public on Mondays and Saturdays there has been a good attendance, a total of 6,000 persons having attended on eleven of the Mondays. It had been claimed that fellows would resign if the grounds were open to the public, but instead of that the roll of fellows had been greatly increased. The plan of having promenade concerts in the garden has not been favored by the council, but will be again considered.

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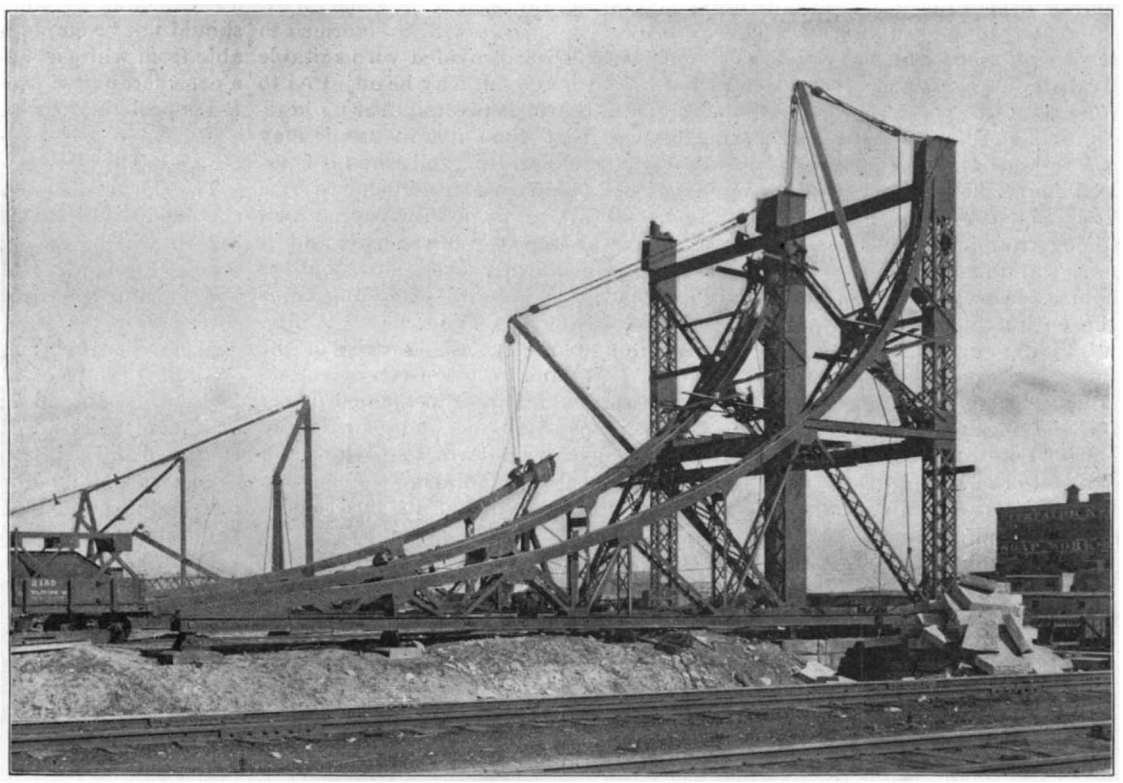
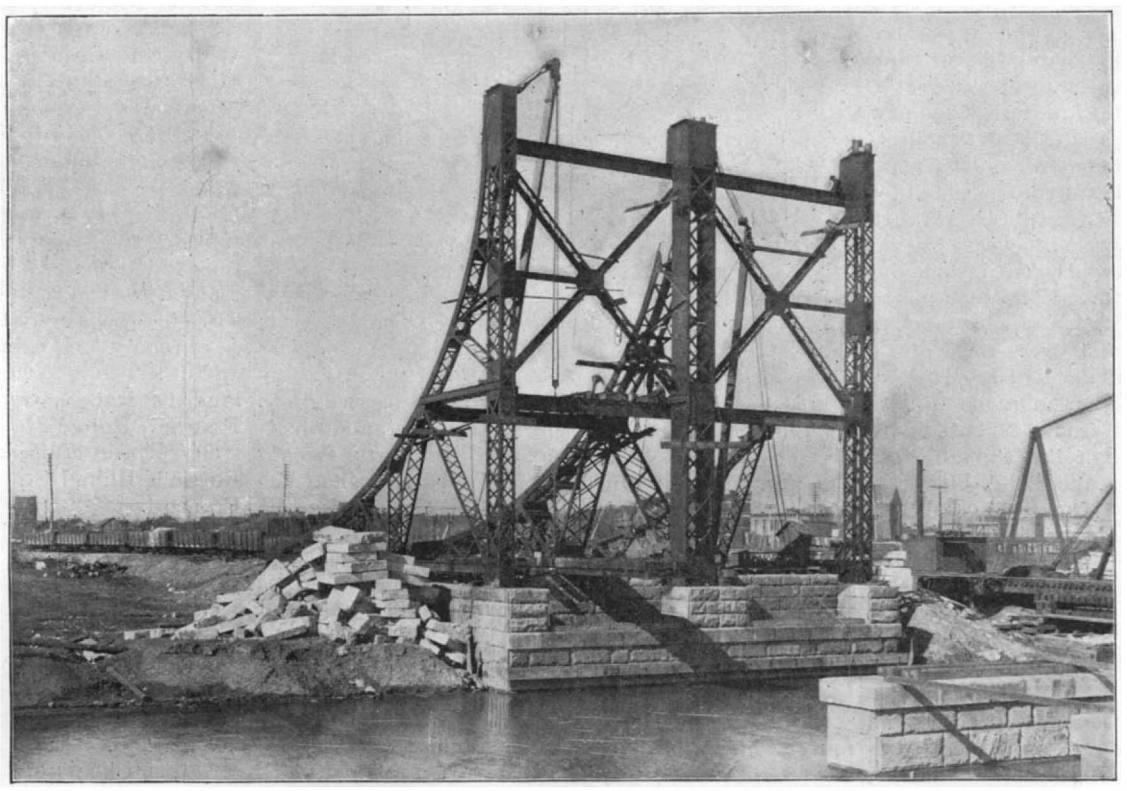
A NOVEL RAILROAD BRIDGE.

Some time since, when the Chicago & Northern Pacific Railroad acquired the right of way from the Stock Yards Company for the location of its line to the Chicago Stock Yards, one of the provisions in the agreement for additional right of way was that a new swing bridge should be put across the south branch of the Chicago River at Blue Island by the Chicago & Northern Pacific Company. As the Pan Handle road crosses this branch of the Chicago River at a point so close as not to permit room for a one span swing bridge, a double swing was first determined upon, but this proposition was abandoned on account of its expense, and it was finally decided to construct a counter-weighted lift bridge of a new design based on the principle of loaded buggies running on elliptic shaped tracks and acting as counter weights. We herewith illustrate two views of this bridge now in the course of construction, which shows the progress that has so far been made upon the work and indicates the general principles of the bridge. It consists of three upright posts, the middle post double the size of the outside ones. From the top of these towers in the form of a section of an ellipse run four girder tracks to carry the loaded buggies acting as counter weights. These elliptic tracks extend away from the towers at the base 99 feet. It is a four-track bridge of two spans of 60 feet 4 inches each and one middle girder span of 34 feet, but only one span of the bridge is designed to lift under the present construction. It is so arranged that in the future, when desired, posts of the same design can be erected on the opposite bank of the stream and the other half of the bridge lifted in the same way. The bascule consists of eight 70 foot girders 6 feet 2 inches deep that weigh about 21,400 pounds each. The tower posts stand 64 feet 9¾ inches high over all. Sheaves are fitted at the top of all the towers, the outside ones having three grooves each and the sheaves of the middle tower three grooves in the middle sheave and two outside sheaves with one groove each. The four counter weights are attached to the lifting girders by 1¼ inch steel cables running over the sheaves. They weigh 53,500 pounds each. Chains are also attached to the girders and run over the sheaves at the top of the posts to a stationary engine located immediately above the tracks on a floor built between the posts and the elliptic track. When the bridge is in position for traffic the components of the weights of the buggies and of the bascule are such as to favor the latter. By the action of the stationary engine, working an endless screw, this is overcome and the platform is raised to a perpendicular position, the girders hinging at the bottom of the posts at the bridge seat. When the platform is entirely raised for the passage of boats the components are changed in their relation and the platform is held in an erect position, requiring action of the engine to lower the lift. The engine is double and manufactured by the Crane Elevator Company, of Chicago, and is arranged so that half of the lifting portion of the bridge can be operated independently if desired. It also can be operated by hand when required. The width of the posts, center to center, is 59 feet 6 inches. Mr. George S. Morison, acting jointly with the officials of the Chicago & Northern Pacific Railroad, determined this to be the best design for this particular location under the existing circumstances, and Mr. Morison has given the facts in this article. Mr. H. R. Stanford, of Mr. Morison's office, associate member of the American Society of Civil Engineers, is the inspector. For our engravings and the particulars we are indebted to the courtesy of the Railway Age and Northwestern Railroader.



A NEW TYPE OF LIFT BRIDGE—SIDE VIEW.



A NEW TYPE OF LIFT BRIDGE—END VIEW.

Soapstone Quarries of Virginia.

Albemarle County, Virginia, is the home of many industries, but perhaps the most interesting one is the soapstone quarry of Alberene. Among the foothills of the Ragged Mountains is a tract of 1,950 acres, fringed with woods and dotted with tidy homes, a little world in itself, its interests centering where the great derricks mark the sky and long buildings cover busy saws. Twelve years ago it was a quiet farm, but one day a horseman appeared riding slowly, with observant eyes, a man of experience, an expert in soapstone. Here he found outcropping a vein of soapstone, the finest in the world. He looked long and carefully, then he went away, but it was to form a company which bought the place. They began operations at once.

With a force of thirty-five men and inadequate machines enough soapstone was put on the market to establish its reputation and create a demand. To-day, with a force of two hundred and twenty-five workmen and highly improved machinery, the output does not supply the demand. Extensions and improvements are constantly in progress, and the capacity of the vein is practically limitless.

The first quarry opened showed a vein from thirty-five to forty feet wide, inclined at an angle of sixty-three degrees. Excavated to a depth of one hundred and sixty feet, it still yielded fine blocks of workable stone. At the end of six years this quarry was abandoned, and about twenty feet away another quarry was opened and worked in the same way. There are now three quarries in operation. Large Ingersoll channelers are used in them to drill out the blocks; they are run by steam, and, in spite of the hardness of the stone, cut about the sides of each block with amazing rapidity. The average block weighs nine tons, but the derricks used are capable of raising as much as twenty tons. Once out of the quarry the blocks are put on steam trucks and carried to the factory, where they are cut into slabs of varying thickness. This is done by abrasion. Gang saws swing to and fro over chilled iron globules that wear away the stone, as they are kept continually moving. Each slab is then examined and moved on its truck to be cut into the shapes for which it is best adapted. The manufactured output is about sixty-three tons per day.

As acid has absolutely no action upon the stone, it is used to make tanks for jewelers; dissecting rooms and laboratories are fitted up with it, and, on account of its non-absorbent qualities, it is in great demand for laundry tubs and sinks. It is also used for fireplace linings and for griddles, the latter having a great advantage over the iron griddles, as they never require greasing.

The Alberene soapstone is exported all over the world, for its smooth texture and hardness render the articles manufactured from it absolutely time-defying in their durability. Four car loads of this stone are in the laboratory at Yale; at Tiffany's there are acid tanks; the Hahnemann Hospital, at Chicago, and the Vanderbilt Clinic, of New York, by their use testify to its merits, and the University of Mississippi has set an example which the South and West are speedily following.

For years this soapstone was put on the market at a loss. The very quality which gives it superiority made the difficulty. No machinery could match its hardness. Machines had to be invented that could cope with it, and in the struggle raw recruits have become trained workmen. These workmen are nearly all whites of the laboring classes from the country round about. A couple of Swedes, a German or two and a Frenchman represent the foreign element, and the force of negroes who fill out the necessary quota of employes are those who, in the twelve years of the quarry's existence, represent the survival of the fittest. Altogether, it is a thriving, bustling colony, and what was a venture is now an established business on firm footing, its success adding much to the steadily growing prosperity of Albemarle.—C. S. Coles, in The Tradesman.

D. E. PACKER, of South Birmingham, England, has lately given out some results of experiments in photographing the solar corona in daylight. By placing screens of tin and lead foil or thin sheets of copper over wide camera apertures, or better still over a pin hole aperture, he has succeeded in receiving impressions on sensitive plates of the corona alone, the sun itself appearing black as in a total eclipse. Some of his deductions are extremely interesting, notably that of the intimate connection of the coronal streams with sun spots and sun spot groups. Indeed, he says that "it may be regarded as an axiom that every sun spot has its coronal ray." He has also detected a decided heliacal structure in the radiations. He concludes that the corona is an electrical phenomenon

THE University of Edinburgh has received a bequest of $100,000 from the late Earl of Moray as an endowment fund for the promotion of original research.

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Science Notes.

The fourth centenary of the discovery of India by Vasco da Gama will be celebrated by an exhibition in Lisbon next year of Indian products, in which Senor Aronca is instructed to invite England to take an important part.

A phosphorescent 5 o'clock tea was recently given in Paris at 8 in the evening, at which no lights were used, the light coming from the ceiling, carpets, chairs, pictures, teacups, and flowers. The ladies wore phosphorescent dresses, and their faces, shoulders, and arms gleamed with light. M. Henry, of the Académie des Sciences, has invented a phosphorescent starch which was used on the occasion and which may be employed as a face powder.

Litmus is an admirable indicator of acids and alkalies, but for this purpose can only be relied upon when pure. Its preparation in a pure state is not easy. A new and convenient means of making litmus paper is provided in the litmus pencil. Thus, by merely rubbing paper with the pencil, marks are obtained which are very sensitive to minute quantities of acids and alkalies, according, of course, as to whether the blue or the red end of the pencil has been used.

A sanitary engineer of this city is responsible for the following: A new danger has been found in the tall buildings of our largest cities. It is that draughts of sewer gas from the escape pipes of overtopping buildings come into the windows, chimneys and light shafts of adjacent office buildings or houses. A well known sanitary engineer states that the entire family of a superintendent of a large office building surrounded by loftier buildings suffered from severe forms of zymotic disease including repeated attacks of malarial fever and that even growing plants were destroyed.

William P. Mason, of the Rensselaer Polytechnic Institute, Troy, was once requested to state the weight in grains of a United States gallon of water at 60° Fah., and upon investigation found that much confusion existed on this point. He gives the following results, which are presented in the Pharm. Record:

U. S. Pharmacopœia. 1870	58328·8862	grains.
" " 1880	58329·6	"
Miller's Chemistry	58317·3	"
Am. Chemist, Vol. I, p. 318	58319·8	"
U. S. Dispensatory	58328·886	"
Oldberg's Weights and Measures	58335·218	"
U. S. Treasury Department	8·3312	lb.

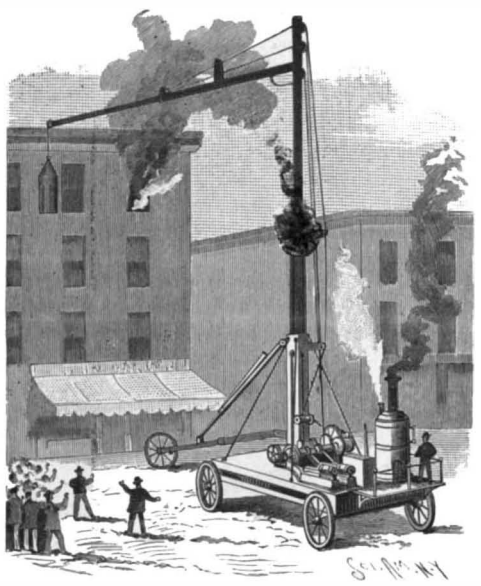
The Astrophysical Observatory at Potsdam is to have a large refracting telescope, says the Astrophysical Journal. With the 11 inch refractor hitherto used for the spectrographic researches of Profs. Vogel and Scheiner, the motions in the line of sight of 51 stars were determined with great accuracy, but it was impossible to photograph stars appreciably fainter than the second magnitude with the large spectrograph. It is reported from Berlin that the aperture of the new telescope will be about thirty inches. The light collecting power of such an instrument should be sufficient to bring stars of the third magnitude and some even fainter ones within reach of the large spectrograph, whose range will thus be trebled if not quadrupled.

A correspondent in Nature recently tried some interesting experiments with formic acid, which has so repeatedly been recommended to promote a magical growth of plants. The seeds used were those of the Scotch thistle. He used formic acid diluted 1-5000. The experiments were carried on in a greenhouse where the temperature ranged from 55° Fah. to 75° Fah. The seeds showed no sign of life, though those planted under ordinary circumstances did. He then procured pure concentrated formic acid; the result was the same. Various other seeds were then tried with no success. His conclusions are that the acid retarded the growth of the seeds, but seemed to increase their density. He also tried the injection of formic acid (1-5000) into growing seeds and bulbs with no effect.

In a recent Chemical Society paper on "The Temperature of Certain Flames," by W. N. Hartley, F.R.S., the author mentions that he found no practicable means of measuring their temperature, owing to the disproportionate size of the measuring instrument—a thermo-electric couple, for instance—compared with the effective volume of the flame. He measured the temperature of flames by means of gold leaf and with fine wires of platinum 1-3000 inch diameter, such as were drawn by Wollaston and used by Faraday, also with pure platinum wire 1-1000 inch thick. He furnishes evidence of the high temperature of a candle flame, not only from the melting of gold and of platinum in the flame, but by an examination of the spectrum to be seen in the mantle. Experiments made with platinum wires heated in a batswing gas flame are described, which proved that the carbon does not lower the melting point of the platinum, at any rate in any appreciable degree. A small carbon monoxide flame melts platinum wire 1-1000 inch in thickness, and a cyanogen flame was shown to be intensely hot, for it melted such wire with extreme ease. The author believes that his experiments have dissipated the doubt that was cast on Professor Smithells' statment of the high temperature of the mantle of the Bunsen flame, and confirm his own estimate of the high temperature of the Bessemer flame.

A NOVEL FIRE ESCAPE.

The invention shown in the illustration has been patented by Mr. John Alexander Dobkins, of Lebanon, Oregon. It is intended to provide a portable fire escape, specially adapted, by means of a laterally extended arm, to reach the windows of a building which are above the level of such obstructions as electric wires, etc. A stout sill frame, which is mounted upon wheels for convenience of transportation, is provided with a framed platform, or turntable, in which is securely fixed the base of a vertical telescopic mast, the heel of the same being stepped in a suitable pivotal support on the frame of the car. The mast is in three sections, and each section is provided with a wire rope by means of which it may be hoisted to the required height, said ropes passing over suitable pulleys and leading down through the mast to a sheave, from which they lead to the hoisting engine. Near the upper end of the top mast is provided an extensible horizontal swinging arm, which is formed in two parts, the outer one being provided with suitable pulleys and wire rope whereby it may be adjusted to the desired length. This arm is pivoted near its junction with the mast, so that when not in use it may be folded down upon the platform, and when it is extended, and in use, it is supported from beneath by a curved brace and from above by a wire rope, which passes over a sheave at the top of the mast and is carried down to a winch drum over loose pulleys which are adjusted on short laterally extending arms attached to the lower sections of the mast. A fireproof cage is provided to receive the inmates of the burning structure. It is hung from the end of the extensible arm by means of a wire rope, which passes over sheaves at the end of the same, and near the top of the mast, and is then carried down to the drum of the hoisting engine. To assist in bracing the mast an extensible arm is provided, having at its outer end a



DOBKINS' FIRE ESCAPE.

suitable wheel which bears upon the ground. At its inner end said arm is pivotally connected to the base of the mast. Attached to the center of the extensible arm is an extensible prop brace which is carried up to the top of the lower section of the mast, and pivotally connected to the same. By this arrangement the arm may be conveniently folded up when the fire escape is in transit. It will be seen from the above description that, upon arriving at the scene of a fire, the apparatus may be quickly adjusted to the required height, and the fireproof cage may be placed at any desired window for the rescue of the inmates of the upper floors.

Visibility of Lights at Sea.

As a result of the discussion of the subject of anchor and running lights by the International Maritime Conference in Washington, in 1889, says the New York Sun, special investigations were undertaken by officers of the governments of the United States, Germany, and Netherlands to determine the intensity of light needed to fulfill the requirements of the law governing the rules of the road, which says that "the word 'visible' in these rules shall mean visible on a dark night with a clear atmosphere." The result of a large number of observations by the German committee gave as the distance at which a white light of 1 candle power became visible, 1·40 miles for a dark clear night, 1 mile for a rainy one.

The American experiments, undertaken at Long Beach light station, gave the following results in very clear weather: A light of 1 candle power was plainly visible at 1 nautical mile and one of 3 candle power at 2 miles. A 10 candle power light was visible with a binocular at 4 miles, one of 29 candles faintly at 5, and one of 33 candles visible without difficulty at the same distance. On a second evening, exceptionally clear, a white light of 3·2 candle power could readily be distinguished at 3, one of 5·6 at 4, and one 17·2 at 5 miles.

The Dutch governmental experiments, conducted at Amsterdam, gave the following results: A light of 1 candle power was visible at 1 nautical mile, 3·5 at 2, and 16 at 5 miles.

In the experiments with colored lights it is only necessary to use the green, as it has been conclusively proved that if a light of that color fulfills the required tests, a red one of the same intensity will more than do so. It was found that the candle power required for a green light to be visible 1, 2, 3, and 4 miles at sea was 2, 15, 51, and 106, respectively.

The extraordinarily rapid diminution of the visibility of the green light with the distance, even in good observing weather, and the still more rapid decrease in rainy weather of a character which will but slightly diminish the intensity of a white light, show that it is of the utmost importance to select for the glass a shade of color which will interfere with the intensity of the light as little as possible. The shade recommended is a clear blue green. Yellow green and grass green should not be employed, as they become indistinguishable from white at a very short distance. For the red a considerably wide range is allowable, but a coppery red is probably the best.

The Fleets of the Great Nations.

The Carnet de poche d'officier de marine contains a classified list of the fleets of the great nations, according to which, taking into account only the latest types, England, Italy, Germany, Austria, Russia, France and the United States possess the following ships:

Armored vessels:

(1) Battleships of 13,000 tons and a speed of at least 18 knots: England 7; 10,000—13,000 tons and at least 16 knots: England 11, Italy 4, Germany 4, Russia 3, France 6 and United States 3; 8,000 tons and from 14 to 16 knots: England 11, Italy 3, Germany 1, Russia 6, France 7; and of less than 8,000 tons and less than 16 knots speed: England 1, Germany 9, Austria 4, Russia 1, France 4, United States 1.

(2) Coast defense ships of 8,000 tons and at least 16 knots: England 2; 6,000–8,000 tons and 14–16 knots: England 2, France 9; and of less than 6,000 tons and 14–16 knots: England 1, Germany 6, France 2, United States 2.

(3) Armored cruisers of 4,000–6,000 tons and at least 18 knots: England 9, Russia 3, France 5, United States 2.

(4) Armored gunboats or monitors of 1,500 tons and at least 13 knots: Austria 2, Russia 3, France 8, United States 1.

Other armored vessels: Italy 3, France 5.

Total armored vessels of the latest type: England 44, Italy 10, Germany 20, Austria 6, Russia 16, France 41, United States 9.

Unarmored vessels:

(1) Protected cruisers and torpedo dispatch boats of 8,000 tons or more and at least 18 knots: England 2, Russia 1; 4,000–8,000 tons and at least 18 knots: England 21, Italy 1, Germany 5, United States 8; 4,000 tons and 14–16 knots: England 7, France 3; 2,000–4,000 tons and at least 17 knots: England 31, Italy 13, Germany 1, Austria 2, Russia 3, France 5, United States 6; 2,000–4,000 tons and at least 14 knots: England 6, Italy 4, Germany 7, Russia 8, France 12, United States 2; and of less than 2,000 tons and 14 knots or over: England 19, Italy 5, Germany 17, Austria 1, Russia 10, France 7, United States 8.

(2) Torpedo cruisers of 20 knots and over: Italy 8, Russia 6, United States 1; of 15–20 knots: England 9, France 4.

(3) Torpedo boat destroyers of at least 25 knots: England 11, Italy 5, Germany 4; of 20 to 22 knots: England 11, Italy 1, Germany 6, Austria 6, France 19.

Other unarmored vessels: England 21, France 1, Russia 4, Italy 6, and Austria 6.

Total unarmored vessels: England 138, Italy 43, Germany 40, Austria 15, Russia 32, France 51, United States 25.

Torpedo boats:

Torpedo boats of 120 tons and from 20 to 25 knots: England 2, Germany 15, Russia 17, France 9, United States 1; of 100 tons and at least 20 knots: England 10, Italy 2, Germany 18, Russia 3, France 21, United States 1; of 40–100 tons and at least 20 knots: England 54, Italy 92, Germany 59, Austria 22, Russia 23, France 149, United States 1; of 40–100 tons and at least 18 knots: England 12, Germany 25, Austria 34, Russia 10; and of less than 40 tons and at least 18 knots: England 27, Italy 57, Russia 2, France 37.

Total torpedo boats: England 105, Italy 151, Germany 117, Austria 56, Russia 55, France 216, United States 3.

Grand total:

The total number of vessels of latest type is, therefore, England 287, Italy 204, Germany 177, Austria 77, Russia 103, France 308 and United States 37.

Besides these there are a number of armored vessels of older type, which will be available for defensive purposes as well as in second line. Of these England has 21, Germany 14, Austria 5, Italy 4, France 9 and United States 18.—Journal of the United States Artillery.

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Notice.

A premium of $250 is offered by the SCIENTIFIC AMERICAN for the best essay on

THE PROGRESS OF INVENTION DURING THE PAST FIFTY YEARS.

This paper should not exceed in length 2,500 words.

The above-mentioned prize of $250 will be awarded for the best essay, and the prize paper will be published in the Special 50th Anniversary Number of the SCIENTIFIC AMERICAN of July 25. A selection of the five next best papers will be published in subsequent issues of the SCIENTIFIC AMERICAN SUPPLEMENT at our regular rates of compensation.

The papers will be submitted for adjudication to a select jury of three, consisting of—

Prof. R. H. Thurston, Cornell University.

Judge A. P. Greeley, Washington, D. C.

Prof. R. S. Woodward, Columbia University.

Rejected MSS. will be returned when accompanied by a stamped and addressed envelope.

Each paper should be signed by a fictitious name, and a card bearing the true name and the fictitious name of the author should accompany each paper, but in a separate sealed envelope.

All papers should be received at this office on or before June 20, 1896, addressed to

Editor of the SCIENTIFIC AMERICAN,
361 Broadway, New York.

Compulsory Introduction of Coupling Devices.

Sixteen thousand railroad employes were killed in the discharge of their duties in the seven years from 1888 to 1894. The awful record of the killed and injured seems incredible. During these seven years the exact figures are 16,257 killed and 172,130 crippled, maimed and injured. Few battles in history show so ghastly a fatality.

This slaughter of American workmen is about ended, says the Evening Telegram. A national law, the expression of the Congress of the United States, has called a halt to the heartlessness or heedlessness of railroad companies, and it has been decreed that an army of men shall no longer be offered up as an annual sacrifice to corporate greed.

There is a romance in some statistics and history in others. There are many good people who revile statistics and never glance at a table of figures, but they will find food for thought in a study of the facts presented by the Chicago Times-Herald.

In 1893 the slaughter of railroad employes became so great as to attract the attention of Congress. For a generation it had been known in a general way that a large number of men were being annually killed and maimed, but it was not until 1888 that accurate figures were obtainable. It was also known that a large percentage of these deaths was caused by the use of imperfect equipment by the railroad companies. There was not a city, village or hamlet in the United States but that numbered its maimed and killed. In thousands of homes widows and orphans mourned the loss of fathers whose lives had been crushed out beneath the wheels of railway cars. Here is the record from 1888 to 1894, one year after Congress passed an act designed to check this slaughter:

Employes—	Killed.	Injured.
1894	1,823	23,422
1893	2,727	31,749
1892	2,554	28,267
1891	2,660	26,140
1890	2,451	22,394
1889	1,972	20,028
1888	2,070	20,148
Passengers—		
1894	324	3,034
1893	299	3,299
1892	376	3,227
1891	293	2,972
1890	286	2,425
1889	310	2,146
1888	315	2,138
Other persons—		
1894	4,300	5,433
1893	4,320	5,435
1892	4,217	5,158
1891	4,076	4,769
1890	3,589	4,209
1889	3,541	4,135
1888	2,897	3,602
Totals 1894	6,447	31,889
Totals 1893	7,346	40,393
Totals 1892	7,147	36,652
Totals 1891	7,029	33,881
Totals 1890	6,335	29,027
Totals 1889	5,823	26,309
Totals 1888	5,282	25,888

Note the marked decrease in 1894 in the number of railroad employes killed and injured. If the figures were obtainable for 1895, the decrease would be more marked. This happy result is the sequence of a law passed in 1893, and is a striking example of what can be obtained by wise national legislation.

It seems remarkable that all inventions designed to protect human life are adopted only after some stern statutory enactment, municipal, state or national. Any invention containing features which fairly promise to protect property needs no support from the law-giving power of a community or a nation. The owner of a building will cheerfully equip it with fire extinguishers and other apparatus designed to save it from a conflagration, but he rarely spends money for a fire escape until some municipal officer enforces a law to that effect. The mine owners in all parts of the world have been progressive on all points looking to the development of their property, and are quick to adopt any method by which the cost of production can be cheapened, but it has been necessary to fill the statute books of both continents with laws before the lives of the miners have been taken into consideration. This seems the natural result of human selfishness. Human life is cheap; property is dear.

Railroad companies have been no exception to the rule. Twenty years ago or more it was practically demonstrated that cars could be automatically coupled, and that it was no longer necessary for a railroad employe to imperil his life by stepping between two cars about to be connected. The automatic coupler was soon applied to all first class passenger trains. It was a paying investment. The former methods entailed a constant damage on the expensive passenger coaches, and the railroad companies welcomed the new invention. But they made no move to apply the automatic coupler to freight cars, as these were strongly constructed and contained no parts which were seriously injured by being jammed together. It was different with the expensive passenger coaches, and as before stated, it needed no aroused public sentiment to hasten the change.

In 1893 the list of killed and injured railroad employes reached the appalling total of 2,727 dead and 31,749 wounded. It was time to call a halt, and in response to appeals from all over the United States Congress took up the matter, and after bitter opposition passed the Safety Appliance act. In view of the fact that this is one of the most successful pieces of legislation ever enacted in the interests of workmen, and the further fact that its provisions are now going into effect, the salient sections of this bill are worth quoting at this time. The act reads as follows:

Section 1. An act to promote the safety of employes and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes, and their locomotives with driving wheel brakes, and for other purposes.

Be it enacted, by the Senate and House of Representatives of the United States of America in Congress assembled, that from and after the first day of January, 1898, it shall be unlawful for any common carrier engaged in interstate commerce by railroad to use on its line any locomotive engine in moving interstate traffic not equipped with a power driving wheel brake and appliances for operating the train brake system, or to run any train in such traffic after such date that has not a sufficient number of cars in it so equipped with power or train brakes that the engineer on the locomotive drawing such train can control its speed without requiring brakemen to use the common hand brake for that purpose.

Section 2. That on and after the first day of January, 1898, it shall be unlawful for any such common carrier to haul or permit to be hauled or used on its line any car used in moving interstate traffic not equipped with couplers coupling automatically by impact, and which can be uncoupled without the necessity of men going between the ends of the cars.

Section 3. That when any person, firm, company, or corporation engaged in interstate commerce by railroad shall have equipped a sufficient number of its cars so as to comply with the provisions of section 1 of this act, it may lawfully refuse to receive from connecting lines of road or shippers any cars not equipped sufficiently, in accordance with the first section of this act, with such power or train brakes as will work and readily interchange with the brakes in use on its own cars, as required by this act.

Section 4. That from and after the first day of July, 1895, until otherwise ordered by the Interstate Commerce Commission, it shall be unlawful for any railroad company to use any car in interstate commerce that is not provided with secure grip irons or hand holds to the ends and sides of each car for greater security to men in coupling and uncoupling cars.

In its remaining sections the act authorized the American Railway Association to designate the standard height of drawbars for freight cars, and stipulated that on and after July 1, 1895, no cars used in interstate traffic should be used unless they complied with this standard. Section 6 provides that "any such common carrier using any locomotive engine, running any train, or hauling or permitting to be hauled on its line any car in violation of any of the provisions of this act, shall be liable to a penalty of $100 for each and every such violation, to be recovered in a suit or suits to be brought by the United States District Attorney in the District Court of the United States having jurisdiction in the locality where such violation shall have been committed, and it shall be the duty of such District Attorney to bring such suits upon duly verified information being lodged with him of such violation having occurred." The last section is so framed that any employe injured by a train not equipped in conformity to the act "assumes the risk occasioned thereby." He would, therefore, have no redress in a suit for damages.

This bill was approved by President Harrison March 2, 1893, and was one of his last official acts. The prediction was made that it would be disregarded by the railroad companies or that it would be fought in the courts and defeated. Neither prediction has come true. On the contrary, the railroad companies have, with a few exceptions, extended their most hearty cooperation in an effort to fully meet the requirements of the safety appliance act.

Before January 1, 1898, all of the great trunk lines of the United States will have complied with the provisions of this law. More than that, the more important roads have already made such progress that the death rate from accidents to railroad men has already decreased thirty-five per cent. In 1894 the number killed had decreased by 904 and the injured by 8,307. It is doubtful if any law ever enacted can show such direct and startling results.

It has been conservatively estimated that it has or will cost the railroads of the United States not less than $50,000,000 to fully comply with the provisions of this law. Such roads as the Northwestern, the Chicago, Burlington and Quincy, the Lake Shore and other well managed roads have set aside a monthly sum to be devoted to this work and have so planned that their entire equipment will be in shape before 1898.

Book Production in the United States in 1895.

The New York Publishers' Weekly prints the following analytical table of the books published in the United States during last year, the figures for 1894 being included for purposes of comparison:

CLASSIFICATIONS.	1894. New Books.	1894. New Editions.	1895. New Books.	1895. New Editions.
Fiction	573	156	1050	64
Law	440	45	480	51
Theology and Religion	442	26	471	35
Education and Language	426	16	456	32
Literary History and Miscellany	208	29	455	13
Juvenile	315	29	365	10
Political and Social Science	233	21	313	22
Poetry	133	133	294	15
Physical and Mathematical Science	141	24	198	24
History	163	24	185	8
Biography, Memoirs	140	21	167	13
Medical Science, Hygiene	118	42	141	22
Description, Travel	116	28	124	27
Fine Arts and Illustrated Books	127	11	133	7
Useful Arts	118	20	100	11
Mental and Moral Philosophy	42	7	55	6
Domestic and Rural	42	9	48	4
Sports and Amusements	50	6	34	4
Humor and Satire	10	...	32	..
Totals	3837	647	5101	368
		3837		5101
		4484		5469

"The classification of fiction for 1895," remarks the editor, "shows a great excess over the novels of 1894; there were 1,114 to 729 of the previous year; among them were some translations from the French, German, Spanish, Italian, Russian and Polish. In law, theology and religion, education and language, juvenile literature, and in fact in every other department, excepting political and social science, for many years so rich in American contributions, and in medical science, useful arts and sports and amusements, the figures ran far ahead of any previous record. In the latter departments they fell behind 1894."

John C. De la Vergne.

John C. De la Vergne, the president of the De la Vergne Refrigerating Machine Company, of New York City, died on May 12. He was born in 1840, and after engaging in various lines of business, he bought an interest in a brewery. It was while engaged in the brewing business, in which ice was used, that he turned his attention to the manufacture of refrigerating and ice making machinery, and designed a compressor with a liquid sealed piston, which prevents the leakage of ammonia gas through the stuffing box, and at the same time lubricates the machinery. The invention made it possible to put the pipes containing the ammonia directly into the rooms, instead of first cooling salt water and then forcing through the rooms.

The success of this invention so encouraged Mr. De la Vergne that he tried it elsewhere, and succeeded in securing contracts for refrigerating plants from several large brewers, in Brooklyn, Newark, N. J., and Philadelphia, and in 1880 he organized what is now known as the De la Vergne Refrigerating Machine Company. At first the place of business was in Bank Street, but in 1888 the company purchased a large tract of land in East One Hundred and Thirty-eighth Street (Port Morris), upon which their present extensive works were erected. At this plant about eight hundred men are employed, and the company gives employment to about four hundred more throughout the country at their various agencies.

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THE IMPROVEMENT OF THE NORTH RIVER WATER FRONT, NEW YORK CITY.

When, in the year 1626, the West India Company purchased Manhattan Island from the Indians for sixty guilders, a sum equal to twenty-four dollars of the present day, no one could have foreseen the immense expense to which the city would eventually go to increase its area. While recently action has been taken to increase the area of the city by the annexation of many square miles of territory, work has been carried on for three centuries, almost unsuspected by the general public, in the increasing of the area of Manhattan Island proper by filling and making artificial ground extending on both sides into the Hudson and East Rivers respectively.

In former times the island was very much narrower than it is now, and old maps show the lower part of the island extending in width barely from Broadway to the present Pearl Street. Since olden times filling has gone on along the water edge for generation after generation until many blocks have been added and the island has been increased by the addition of area on its outer periphery precisely in the place where the addition counts the most. Originally the junction of Pearl Street and Maiden Lane marked the entrance of a wide canal, and another wide canal ran up Broad Street, beginning at Front Street and extending nearly to Wall Street. These facts indicate the narrow limits of the old city.

The rapid currents of the Hudson and East Rivers, especially the latter, had to be guarded against, and as early as 1654 it was resolved to drive planks into the shore to make uniform "sheet piles" between Broad Street and the City Hall for the lower part of the city, and many other ordinances touching on the subject of the water front were passed. The act of 1654 is the first formal attempt to construct a statutory bulkhead.

The map which we publish will serve to give a good idea of the enlargement of the city area. It is only within modern times that the limit of enlargement has been fixed and bulkhead and wharfhead lines located to determine the extent to which filling and dock building operations could be carried out. The map in its shaded portion shows the limits of the lower ends of the island, while in outline are given the additions up to the present time.

On the Hudson River front the city, since 1871, has been working to improve the street and wharfage facilities and has gradually been constructing an unequaled river street, which it is proposed to have extended in time from the Battery far to the north. One of our cuts shows a view of West Street, which is the name of the street running along the North River, presenting a portion where it has not been widened. The illustration serves to show how congested traffic is, and also brings out another point, as to how many wharves are involved in the traffic, and what large portions of the street are occupied by wagons standing to receive their loads.

The general arrangement, following the plan of 1871, provides for a bulkhead wall about 180 feet west of the old bulkhead line, the latter an irregular one cut into by slips. The proposed improvement, now in active progress, increases the width of the street from an average of about 70 feet to the uniform width of 250 feet. We have described fully in a preceding issue engineering features of the work, especially of the bulkhead whose construction is shown in two cuts. In one case it is shown as established on a sloping bed of rock, concrete in bags being used to provide a level bed. Construction of this type is applicable below Barclay Street and above Thirty-fourth Street in places; elsewhere the entire structure must be built upon piling, which in many cases cannot be driven deep enough to reach solid ground, so that what is defined by the engineers as a genuine case of mud flotation is exemplified in numerous places. Wherever the wall has settled in such parts, it has gone down so evenly that no harm has been done.

The concrete blocks which go at the base of the bulkhead wall, and which weigh some 70 tons apiece, are made in moulds and handled by the great floating derrick of the dock department. The operation of moving the blocks is illustrated in another of the cuts.

MAP SHOWING ENLARGEMENT OF MANHATTAN ISLAND BY FILLING.

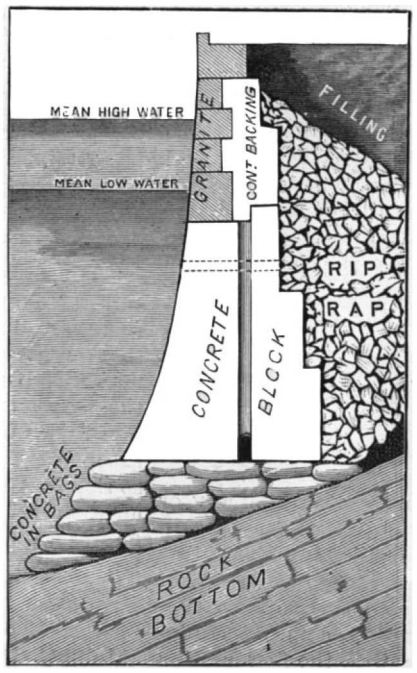
Another of the views shows in bird's eye projection what is to be accomplished eventually. On this cut is seen a portion of the old street on which the improvements have not been effected, and on the same cut can be traced the new Hudson River front, where West Street has been widened and is occupied by the public. Another view shows the scene at a busy hour on the widened street, illustrating very clearly how a great improvement has been effected in facilitating traffic.

The exceptionally wide street, it is anticipated, will divide itself into three longitudinal sections. Fifty feet back of the bulkhead line will probably be devoted to sheds used in connection with the pier service. The next 80 feet, it is thought, may be used for the storage of heavy commodities which will not suffer by exposure to the weather. This disposition will leave 120 feet clear for traffic. It is the arrangement recommended by the consulting engineer of the department of docks of the city of New York, and is accompanied by the recommendation that the whole street be put under the control of the dock department.

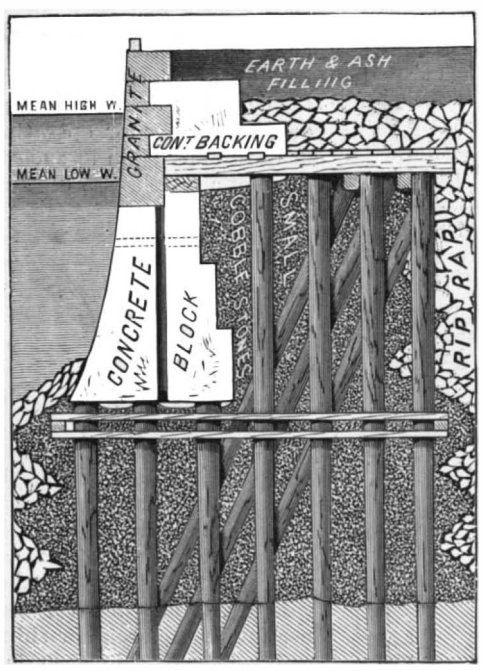
Besides the bulkhead wall and the filling in of the area back of it, the city has done a great deal of work upon the piers proper. It has obtained a title to much of the land; of the lower 2½ miles, 1½ miles belongs to the city. The city leases docks and thereby obtains revenue for its investment. The permitting tenants of the docks to encroach for 130 feet upon the wide street makes the docks more valuable, bringing in a higher rental, and is not in the direction of overlooking encroachment.

Pier 1, on the North River, is a stone structure and an example of what can be done if deemed desirable, but the practice adopted has been to build the piers on the most modern lines yet at less expense; they represent the best practice of timber docks. The tenants build upon them sheds, in some cases two stories in height, and the ferry companies have built their ferry houses outside the bulkhead lines also. The engineers reporting on the subject advocate strongly the use of bridges across the street for the use of the ferry passengers, in order to leave the street as little interrupted in its uses by pedestrians crossing as possible. The commissioners of the department of docks of New York City appointed as a board of consulting engineers to report on the work the following representative men: late Gen. Thomas Lincoln Casey, Chief of Engineers, United States Army; Mr. George S. Morison and Prof. W. H. Burr, all distinguished members of the American Society of Civil Engineers.

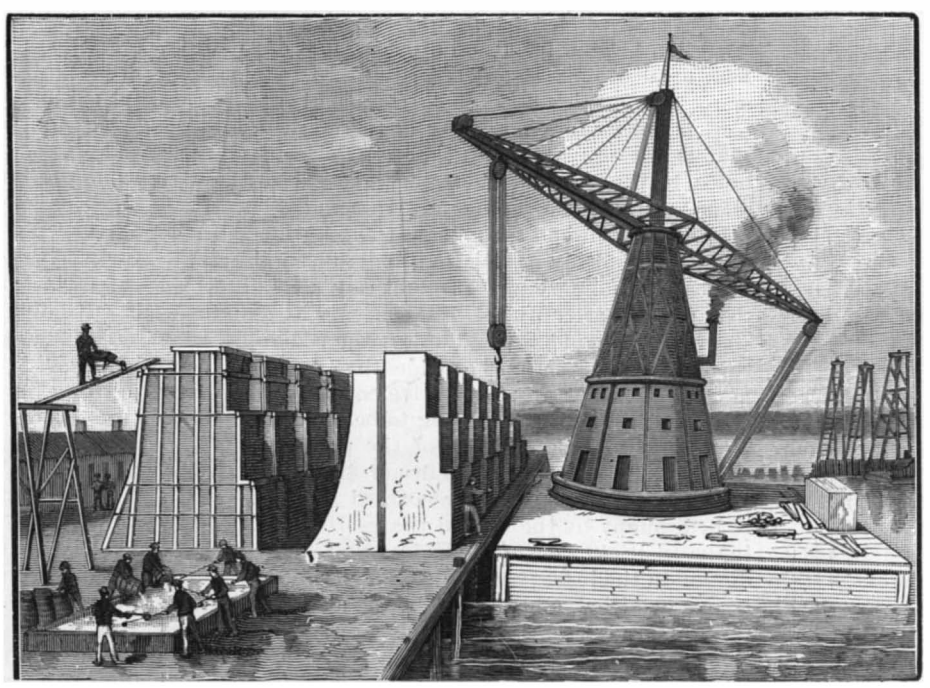
We are indebted to their report, which has recently been rendered, for much of the information in this article. The work has been executed under the late Gen. Geo. B. McClellan and Mr. G. S. Greene, Jr., his successor. As regards the future operations, the most striking feature advocated is the construction of immense graving docks for the accommodation of ocean steamships of the largest size. In the territory between Forty-ninth and Fifty-third Streets is a site for three docks parallel with each other, about 800 feet long within the bulkhead line, with possibility of extension beyond the bulkhead line to about 1,000 feet. Their recommendation is to have one of the docks of the maximum size and the others smaller. It would seem also that the acquirement by the city of title to the entire front should be included in the scheme. As it is now, the city owns comparatively little property below Barclay Street.



BULKHEAD WALL ON ROCK.



BULKHEAD WALL ON PILES.



THE GREAT DERRICK OF THE DOCK DEPARTMENT.

IN a late paper in the Comptes Rendus on the products of combustion of an acetylene burner, and explosive mixtures of acetylene and air, M. M. Grehant states that the combustion of acetylene gas in an ordinary fishtail burner is complete, the products not comprising the least trace of a combustible gas containing carbon. With mixtures of acetylene and air, the most violent explosion was produced when the volume of air was nine times that of the acetylene.

AT a recent meeting of the Paris Academy of Sciences M. Balland presented a memoir describing an analysis of a sample of rice over a century old. He found the rice only slightly deficient in fat.

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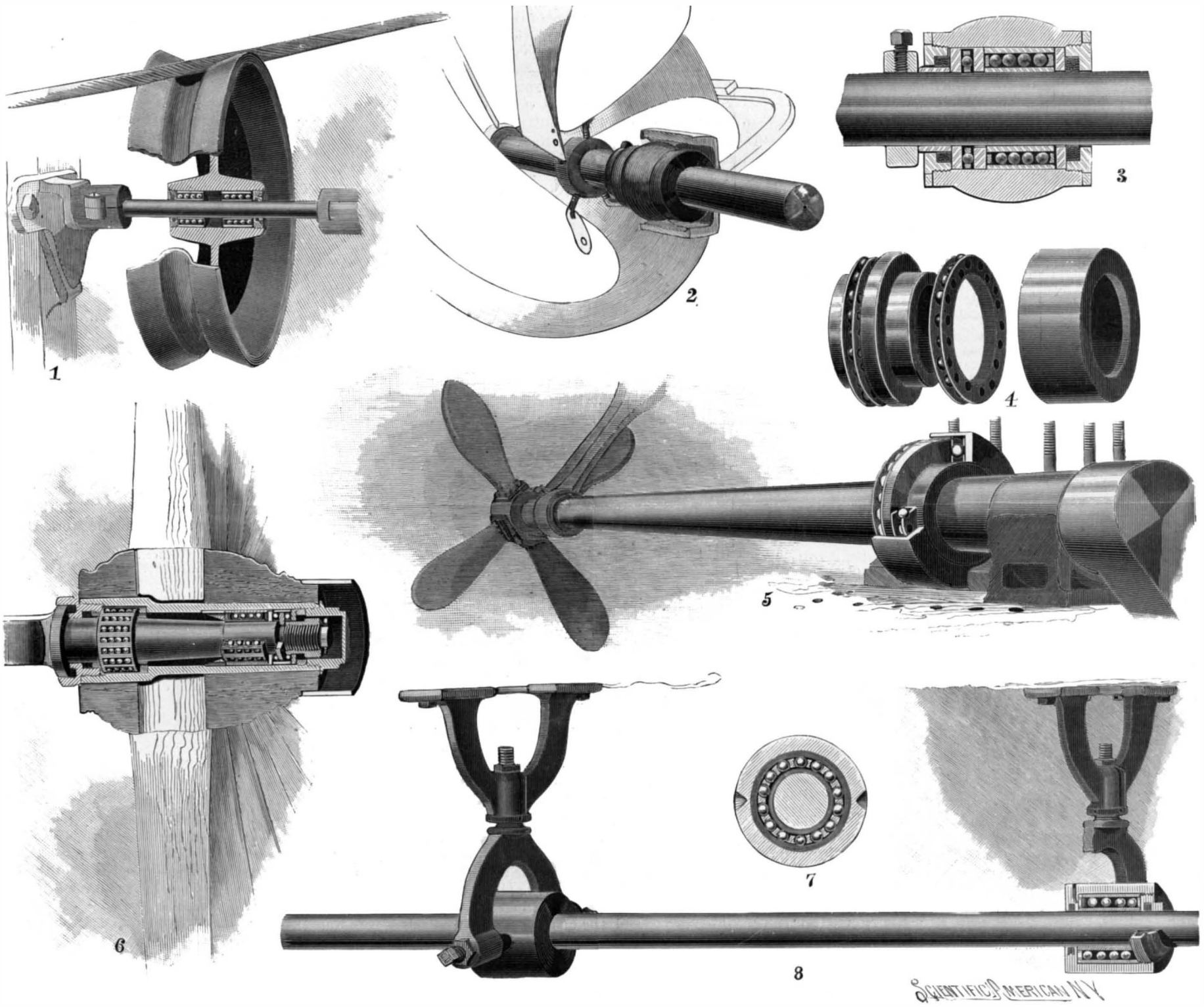
ANTI-FRICTION BALL BEARINGS.

As long as vehicles were propelled by horses or driven by steam, man was content to use the old fashioned surface bearings lubricated by oil in order to make them run more easily. As soon as he began to propel himself on the bicycle, he discovered that ball bearings added greatly to the service by reduction of resistance and by avoidance of lubricants, the latter involving also the disadvantages of want of cleanliness and collection of grit and dust. Bicycles then came to be constructed everywhere with ball bearings. The cheapest machines even are no longer made without them.

Professor Boys, of London, discovered another peculiarity about a ball bearing—that if it is properly constructed it is practically proof against wear. He weighed the balls in a bicycle bearing, rode the machine a long distance and then weighed them afterward, and found that there was no loss of weight. It is only now that the mechanical world is beginning to awaken to the importance of ball bearings.



1. Double radial bearings in cable wheel. 2. Fan with ball bearings. 3. Single radial and end thrust combination. 4. Parts of double end thrust bearing. 5. Propeller shaft with double end thrust bearings. 6. Wagon wheel hub with double radial and double end thrust bearings. 7. Section of countershaft bearing. 8. Countershaft on ball bearings.

ANTI-FRICTION BALL BEARINGS.

We illustrate to-day a number of applications of ball bearings to wagon and machinery work. The devices that we represent are those manufactured by the Ball Bearing Company, of Watson St., Boston, Mass., and they exhibit in their construction at once simplicity, efficiency and applicability to the most varied types of constructions. Referring to them by number as shown in the illustration, Fig. 1 shows what is termed "the double radial bearing," and for further elucidation of the construction of the radial bearing in general, Fig. 6 can be referred to. Its parts are as follows: Upon the shaft is thrust a hardened steel sleeve, which fits it tightly; over this goes a cage which may be seen quite clearly in Fig. 6 on the left hand of the axle. It is a brass cage open radially, which goes over the sleeve and which contains the balls, the brass not touching the sleeve. Outside the cage and resting upon the exterior surfaces of the balls is a second sleeve termed the "facing." The cage with its balls and facing are fastened in the hub of the wheel by washers. When it is thus constructed the cage touches nothing except the balls, simply holding them in place, the outer sleeve and the inner sleeve resting upon the outside and inside of the balls respectively. A wheel so mounted turns with almost no friction and the bearings will wear indefinitely. The balls, moreover, in the cage have lateral traverse allowed them so that they will work back and forth longitudinally, thus avoiding the wearing of the shaft in grooves.

Fig. 1 shows the ball bearings applied to a carrier wheel for a cable. It is evident that such bearings for the wheels would add greatly to the efficiency of a cable road.

Fig. 2 illustrates a fan rotated on ball bearings.

In Fig. 3 we have a new element introduced—the end thrust bearing. The bearing, with four balls close together, is the section of the regular radial bearing just described. To its left is seen a second circle of balls that are contained between two brass plates, which form for them a cage, and the balls bear to right and left on hardened steel washer plates. This gives an end thrust, and as the surface rotates, the balls turn around upon the surface of these plates, the brass simply serving to keep them in position. The whole construction is shown in Fig. 4, and upon observing them more closely it will be noticed that the end thrust balls are staggered, so that consecutive balls shall not follow the same path, the avoidance of the formation of grooves being again obtained.

Fig. 5 shows a double end thrust bearing arranged for push or pull, it being readily understood that the bearing shown in Figs. 3 and 4 is only adapted for thrust in one direction, while Fig. 5 shows one adapted for both stresses, and designed especially for use on propeller shafts. By employing such a bearing the friction, of course, may be reduced to almost nothing, but above all the troublesome heating of the thrust blocks is completely done away with.

Fig. 6, to which we have already alluded, illustrates a complete hub bearing for a carriage. Here we have to the right and left the radial bearings designed to give an extended axis of support to the wheel, but as the wheel is subject also to shocks in the end direction a double end thrust bearing is placed toward the outside extremity of the hub, so that when running upon an incline or upon a level, the wheel may be said to be nearly frictionless and perfect in its action.

Figs. 7 and 8 illustrate the application of ball bearings to shaft boxes and show how admirably adapted it is to this somewhat critical construction. Here we find the two boxes suspended between centers, each of these carrying its four circles of balls in the cage and presenting a really typical shaft box, and one requiring the minimum of oiling, at best a disagreeable operation and one that has frequently been the source of accidents to oilers.

Difference of Temperature Between Water and Its Inhabitants.

This has already been investigated by many experimenters with ordinary thermometers, says Gaea (Leipsic), but the results were as different as possible. Some held that the creatures in water were warmer than the water itself; others found that the water was warmer than its inhabitants, and still others maintained that both were of the same temperature. Herr P. Regnard has now made new measurements by thermo-electric methods. He thrust into a fish that was swimming in an aquarium a needle consisting of a thermo-electric element, one of whose junctions remained outside in the water. The whole was so arranged that the thermo-element could be carried about by the fish without breaking connections. The fish, at first somewhat restless, soon became still, and swam about quietly as before; then the circuit, which contained a galvanometer, was suddenly closed, and thus it was shown (by the absence of deflection in the galvanometer) that the temperature in the fish was almost exactly that of the water. (For if there had been a difference, the junction in the fish and the one in the water would have been unequally heated, and a thermo-electric current would have been generated.)

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The Rail Joint Problem on Trunk Railroads.

The great increase which has taken place in late years in the weight and strength of steel rails on trunk lines has made the problem of providing a strong joint a much simpler matter than it was in the days of the old fifty pound iron rails. But though the difficulties have been lessened, they have not been removed; and an analysis of the labor expended by a section gang upon a stretch of first-class track laid with one hundred pound steel rails would show that even here a large proportion of it was devoted to "keeping up the joints."

Despite the existence of various well known and very excellent rail joints, many of which claim to make the joint stiffer than the rail itself, and can point to certified laboratory tests in proof of the claim, it is true to-day, as it was a generation ago, that the weak places in the track are invariably to be found at the joints.

It is not so difficult to provide a successful joint on street railways, because the deep girder rails which are now being used provide sufficient depth for the use of an exceedingly stiff joint; moreover, the electrically welded joint, where the weld is a sound one, gives promise of good results. The trunk railroad, however, is denied both of these advantages. Considerations of stability limit the depth of the rail, and it is not likely that the welded joint could successfully withstand the pounding of heavy express and mineral traffic during the "cold snaps" of a winter season.

The best form of rail joint for trunk lines has yet to be invented. The perfect joint will be designed on a clear understanding of two facts: First, that the rail joint has to act as a bridge across the gap at the rail ends, and must be capable of carrying the whole load of a passing wheel; second, that the ties which form the piers or abutments upon which the ends of this bridge rest are elastic and become depressed under the passing load of the train.

The weakness of the common form of splice or angle bar results from the fact that its depth is limited by the distance from the head of the rail to the rail base, and that its length has usually been made only sufficient to cover the two joint ties. These dimensions prohibit the use of a splice, or bridge, of sufficient strength to withstand the heavy pounding and wrenching to which it is subject by the heavy loads of modern traffic. The new Pennsylvania and Reading Railroad express engine has a concentrated load of twenty-five tons on a single pair of drivers; and it is evident that, to carry this load from rail to rail at the joint without any greater deflection than occurs in the body of the rail itself, requires a greater depth than the three or four inches which are obtainable in an ordinary angle bar splice. Moreover, if the joint ties were absolutely rigid, the bending moments set up in the joint by the passing load would be determined by the length of the joint itself. But as these joints are depressed under the load, it follows that a portion of the weight is thrown upon the ties adjoining those at the joint, and that the bending moments are those due to a leverage measured from these, and not from the joint ties.

This explains the discrepancy between the results of laboratory tests of a joint, in which the distance between supports is made the same as that ordinarily between joint ties, and the results in actual practice, where the distance between supports, and the bending leverage, is liable to be much greater.

The necessity for providing a greater depth of girder than could be obtained between base and head of rail led to the adoption of the subrail type of joint, of which there are some excellent types now in use. All of these, however, suffer from the common defect that, though they have sufficient depth for their length, this length is limited to the distance between the joint ties. The good results obtained with the long three-tie angle bar, such as is used on the New York Central Railroad, is largely due to its great length of thirty-six inches; and if the tie immediately under the joint were removed, and the flanges of the angle bars carried below the rail in two deep vertical webs, forming a base plate and girder beneath the two rail ends, it is probable that a great increase in rigidity and strength would be secured. To compensate for the loss of bearing due to the removal of the center tie, those at the joint could be made twelve inches instead of the customary eight inches in width.

We should thus have a heavy subrail girder joint three feet long with six or seven inches of effective depth resting upon ties six or eight inches deep by twelve inches wide. Such a joint would be costly, but it would be none too strong to resist the wear and tear of the heavy engines and cars of express traffic. It is probable that it would ultimately pay for itself in the reduction of expenses of maintenance. Of course, the roadmasters would object to the introduction of two sizes of ties and the sinking of an eight inch tie two inches deeper into the ballast than the average tie; but when a section gang had become accustomed to the new sizes, they would be found to give but little inconvenience.

Nothing has prevented the development of a good rail joint as much as the desire to keep down its size and cost, and never was economy more falsely placed. If any inventor can provide our trunk railroads with a joint which in practice shall prove to be as rigid as the body of the rail itself, and that shall absolutely preserve both level and alignment, its first cost will prove to be a minor consideration.

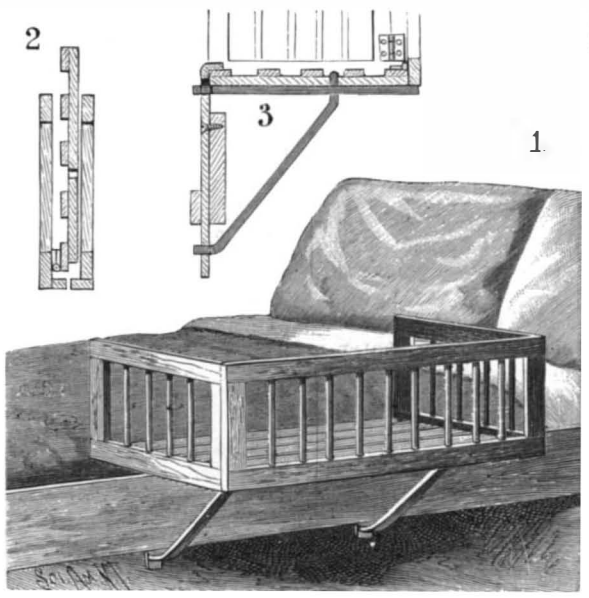
The introduction of sixty foot rails will favor the use of heavier and more costly joints, for it reduces the number of joints to the mile by just one-half. A company could spend just twice as much per joint and yet be at no greater total expense than before.

One by one the later designs have incorporated the essential features to a good joint, such as the side flanges to the angle bar, the base plate under the rail ends, and the subrail girder with its vertical strength. It now remains for some one to include all these features in a deeper and longer joint, which shall reach well back into the two rails and bridge the opening with a large margin of strength to spare.

The rail ends should be mitered, as this would materially help to smooth the passage of the wheel over the joint. Moreover a considerably heavier track bolt than those now in use could be used to good advantage.

A CRIB ATTACHMENT FOR BEDS.

The accompanying illustration shows an invention which has been patented by William H. Doughty, of 936 De Kalb Avenue, Brooklyn, N. Y. It consists of a detachable crib, which may be fastened to the bed rail, and will serve to support a child alongside the bed. The crib is supported against the bed by means of two vertical cleats attached to the inside of the bed rail, and two inclined braces, which have a secure footing in the lower ends of the said cleats. The upper ends of the braces are provided with studs which engage the outer ends of a pair of horizontal plates which carry the



A CRIB ATTACHMENT FOR BEDS.

crib, the inner ends of these plates being locked firmly into the upper ends of the vertical cleats above mentioned. By this arrangement a pair of stout detachable brackets is provided upon which the crib can be placed. It is further held in place by the upper ends of the vertical cleats, which are bent over into the form of a hook for this purpose. To provide a good bearing by which it may rest upon the top plates of the brackets, the bottom of the crib is provided with a pair of transverse cleats, as shown in Figs. 2 and 3.

The outer side rail of the crib is hinged to the outer edge of the bottom, and the end rails are respectively hinged to the ends of the side rail, as shown in the sectional view, Fig. 3. By this arrangement the crib may be folded up as shown in Fig. 2, and the brackets being easily disconnected, the whole device may be quickly detached and laid away when not in use.

To assist in holding the side and end rails in position relative to the bottom when the crib is set up, they are provided at their lower edges with inwardly extending cleats. The bottom is also held down in place by means of blocks arranged at the inner sides of each end rail and latches which are attached to the adjacent ends of the bottom of the crib and lock it firmly in place.

Patent—Name—Designation.

The Supreme Court of the United States held, in the recent case of The Singer Manufacturing Company vs. The June Manufacturing Company et al., that where under the life of a patent a name became the generic designation of the thing made, at the end of the life of the patent, the name, with the article patented, became the property of the public, and its use could not be restrained by injunction. The court further held, however, that the right did not exist to use the name indiscriminately or without qualification, so that the public would be deceived by its use into the belief that the thing manufactured was different from what it really was, or that it was made by a person or corporation other than the real maker.—Bradstreet's.

Notice to Our Readers.

In order to obtain the opinion of the readers of the SCIENTIFIC AMERICAN as to what invention *introduced within the last fifty years* has conferred the greatest benefit upon mankind, we publish the accompanying card, which please cut out and return to the editor. Those who preserve the paper for binding and do not desire to deface their files, or who read this notice at a library, will please answer by postal card. It is desired to get as full a vote as possible. The result of the vote will be published in the *Special 50th Anniversary Number of the* SCIENTIFIC AMERICAN *on July 25.*

Editor of the SCIENTIFIC AMERICAN.

Dear Sir:

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Heavy Rainfalls.

The heaviest rainfalls at Augusta, Me., since 1850, from records kept, are interesting in this season of freshets. The following are those exceeding three inches at one fall:

	Inches.
August 25, 1850	3·40
June 24, 1851	3·15
July 9, 1851	3·47
October 30, 1851	3·80
November 21, 1851	4·95
August 26, 1852	3·43
November 27, 1852	3·20
December 20, 1852	3·25
May 26, 1853	4·35
October 27, 1853	4·25
September 23, 1859	3·50
August 26, 1863	3·88
November 17, 1863	6·84
March 7, 1864	3·55
August 1, 1867	3·55
October 14, 1869	3·60
May 7, 1871	3·65
October 12, 1871	6·25
November 16, 1877	4·30
April 28, 1878	3·12
December 11, 1878	4·05
August 19, 1879	6·69
September 16, 1880	3·20
March 12, 1881	3·05
September 24, 1882	3·32
July 24, 1887	6·34
March 6, 1889	3·10
May 7, 1890	3·17
March 13, 1891	3·40
December 30, 1891	3·18
October 23, 1893	3·30
March 2, 1896	6·00

The following are the rains exceeding five inches at one fall:

	Inches.
November 17, 1863	6·84
October 14, 1869	5·60
October 12, 1871	6·25
August 19, 1879	6·69
July 24, 1887	6·34
March 2, 1896	6·00

On February 20, 1870, 6·75 inches of rain fell, the highest water ever known on the Kennebec. The railroad bridge was swept away at that time. It will therefore be seen that that freshet was due to the melting of enormous banks of snow and breaking up of the ice, and not so much to the rainfall.

All rainfalls that have exceeded five inches, with the exception of the last one, occurred during the summer or fall.—Kennebec Journal.

Chemical Vacuum.

Prof. Elmer Gates, director of the new Laboratory of Experimental Psychology at Washington, claims to have recently produced the first absolute chemical vacuum known to science, and from which he has created rays which exhibit strange phenomena never mentioned as being accomplished by the Roentgen rays. The method of making the absolute vacuum was so simple and apparently effective that it is worthy of notice. He took a large, thick test tube made of the hardest potash glass, whose melting point was at an extraordinarily high temperature. Into this he poured, while in a liquid form, a much softer glass, whose melting point was at a comparatively low temperature. Allowing the liquid glass to cool gradually, it formed a solid mass with the tube. After attaching a suction piston to the mouth of the test tube, the whole glass was slowly heated for about thirty hours. At the end of that time the softer glass became liquid again, while the tube still remained solid. By forcing the piston outward the greater part of the molten glass was expelled. Enough was allowed to remain at the mouth of the tube to seal it by cooling in that position. Back of this stoppage there was left a space where there had never been the least quantity of gas, hence, a perfect vacuum.—New Ideas.

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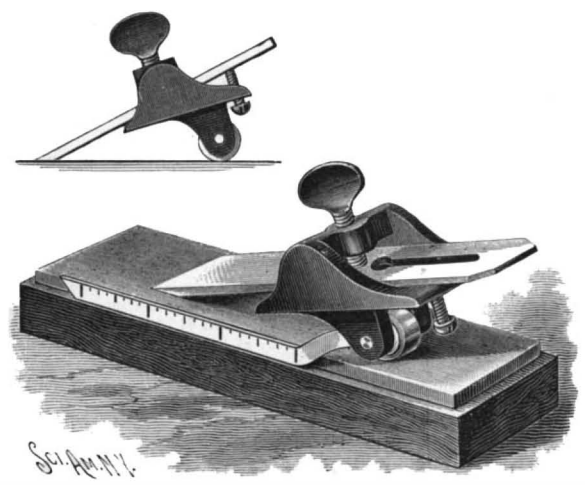
AN IMPROVED HOLDER FOR TOOL SHARPENING.

A patent has been granted to Mr. Geo. Salot, of Dubuque, Iowa, for the invention shown in the accompanying illustration, the object of which is to provide a tool holder, designed for holding chisels, plane bits, and other tools in the proper position while sharpening the same on a grindstone or other tool sharpener, so as to form the desired bevel or angle for the cutting edge.

The holder consists of a flat base, upon which the tool is placed, which has two upwardly projecting sides, carrying a crossbar, the center of which is threaded to receive a thumbscrew, adapted to bear upon the top surface of the tool and hold the same firmly down upon the plate. The under side of the tool holder is provided with a couple of lugs which carry a wheel, said wheel being intended to travel upon the surface of the grindstone. The distance from the under side of the wheel to the upper surface of the holder being constant, it is evident that the angle of the cutting edge of the tool may be made more or less sharp by shifting the tool forward or backward upon the base plate of the holder. In case a very short bevel is required, a set screw is provided close to the rear edge of the plate, by means of which the tool may be raised until the desired angle is obtained. In order to adjust the tool accurately to the proper angle before it is placed upon the grindstone, the holder is provided with a graduated gage, adapted to be hooked on to the shaft of the above mentioned wheel. By adjusting the tool on the base plate of the holder until the cutting edge coincides with the proper graduation on the gage, the desired angle can be formed upon the tool with great accuracy.



SALOT'S IMPROVED HOLDER FOR TOOL SHARPENING.

THE PERMEABILITY OF THE EARTH.

When we make an excavation in a cultivated field in order to observe the development of roots, and then examine a vertical wall well smoothed with the spade, we are struck with astonishment to see how compact the earth is. It appears to form a continuous mass, and we are surprised that it is possible for the air to enter and circulate freely therein.

Now, in order that plants may live, grow, and develop normally, it does not suffice that their stems and leaves shall expand in an oxygenated atmosphere, but their roots also must breathe, and to this effect they need oxygen. The very existence of plants therefore suffices to show that air habitually enters the earth, and is even easily renewed therein, since air that remains for a short time in a closed vessel in contact with the earth very quickly loses its oxygen, which is converted into carbonic acid. If the air did not renew itself in the soil, it would become deprived of oxygen. Now, all analyses of air extracted from the earth reveal therein, on the contrary, a large proportion of oxygen.

Earth is therefore usually permeable to the air, but is it always so? Is all earth permeable to the same degree? And if, at times, it is but incompletely so, and if, even, it becomes impermeable, to what cause is such impermeability due?

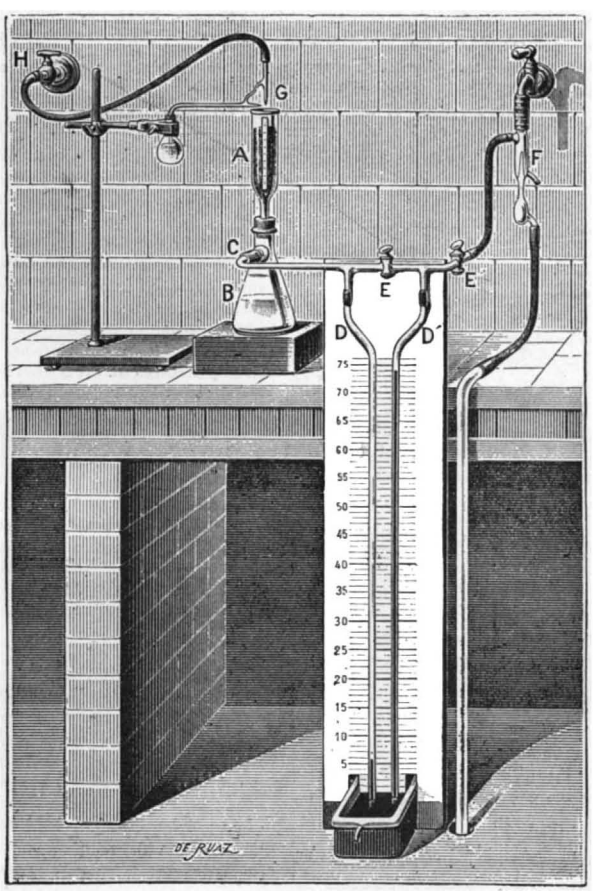
It was in order to answer such questions that Mr. Demoussy (preparator at the museum) and I arranged the apparatus represented in the accompanying figure. In a percolator, A, is placed the earth under experiment in fine powder. The percolator is fixed in a rubber stopper capable of maintaining a vacuum in a tubulated bottle. To the tubulure of the latter there is adapted, through a tight rubber coupling, a tube that is bent at right angles and is fixed to a vertical board. To this tube, C, are soldered two others, D and D', which, after curving toward each other, descend to a small mercury reservoir. Glass cocks, E and E', permit of putting them in communication with or isolating them from a tromp, F, actuated by a current of water furnished by a cock fixed to the wall of the laboratory. A sheet of paper upon which are traced divisions of one centimeter is glued to the board between the two tubes.

When it is desired to moisten the earth, it is sprayed by means of an atomizer, G, analogous in principle to the apparatus used for diffusing perfumes. The current of air is furnished by a blowing apparatus whose nozzle is fixed to the wall of the laboratory.

After the fine earth under experiment has well settled, the air is sucked from the bottle by means of the tromp, F. If the earth is very permeable and is traversed at every instant by a quantity of air equal to that removed from it by the tromp, the pressure in the bottle, B, will be equal to that of the atmosphere, and the mercury will not rise in the tubes, D and D'; but if, on the contrary, the air experiences a certain resistance in traversing the earth, less will enter the bottle than is removed therefrom by the tromp, the pressure will diminish and the mercury will rise in the tubes so much the higher in proportion as the difference between the pressure in the bottle, B, and the pressure of the atmosphere is greater. It will be understood that the height that the mercury reaches in the tubes, D and D', that measure such difference indicates the greater or less permeability of the earth submitted to experiment when it is dry or, on the contrary, after it has received an increasing number of sprayings.

Arable soils are composed of four different elements: sand, clay, lime, and humus. If we investigate the permeability of these various elements to the air, we shall find that it differs greatly. While sand, even when very fine, and dry or moist, is absolutely permeable and allows the air to pass freely, and the mercury does not rise in the tubes when the tromp is actuated, the case is entirely different with lime, and especially with clay. When these are sprayed, the water traverses the mass with difficulty and quickly forms a stratum upon the surface, the air no longer passes, and the mercury rises and reaches 75 centimeters, the limit of the vacuum that can be obtained with the tromp employed. The humus of peat, on the contrary, is very permeable. The water that surmounts the clay or earthy lime finally drains off, even when we cease to attract it by stopping the operation of the tromp, but the mercury remains suspended in the tubes for a long time, and it is not until after one or two days that the pressure is established again in the bottle, B.

If we put some earth into the percolator, A, we very soon see that the permeability decreases with its degree of fineness and its compactness, and we find besides that it decreases again with the quantity of water furnished it. It comes about that an earth that is very permeable after it has received 50 or 100 cubic centimeters of water in a spray becomes more and more impermeable in measure as the spraying is more prolonged. If, however, after each influx of water, we



APPARATUS FOR THE STUDY OF THE PERMEABILITY OF THE EARTH.

weigh the percolator in order to ascertain, through its increase in weight, the quantity of water that it retains, we shall find that such quantity does not increase. So it is not the water interposed between the molecules of earth that prevents the passage of the air.

If we recall, besides, that the permeability is so much the slighter in proportion as the earth is finer and more compact, we shall come to the conclusion that the latter becomes impermeable when the water mixes with the finest portions of it, carries them along into the interstices between the molecules of earth, and then abandons them when its motion slackens. These interstices gradually become obstructed and clogged up and an impermeability is produced.

In fact, we see the earth become entirely impermeable to the air, and the mercury rise in the tubes that indicate a complete vacuum, only so far as the earth is covered with a stratum of water. As soon as this stratum disappears, and the external air can reach the layer of earth, it precipitates itself upon the latter and the mercury descends.

According to these observations, it is patent that if we could render the molecules of earth sufficiently stable, solid and resistant to prevent them from becoming disintegrated or mixed with water, we should have a chance of keeping the earth permeable. Now, we know that a molecule of earth is a small aggregate of sand cemented by coagulated clay. This coagulation of the clay is determined by the carbonate of lime dissolved by the carbonic acid furnished by the slow combustion of the humus.

This decisive influence of the salts of lime upon the coagulation of clay, and consequently upon the stability of the aggregates of earth, and finally upon permeability, is easily shown by a pretty experiment due to Mr. Schloesing.

The clay is stirred up in distilled water, wherein it remains in suspension. This muddy water is preserved thus for several hours without its being observed to become clear. But if we pour into it a small quantity of a saline solution (one of marine salt or of a lime salt, for example), the aspect of the liquid will quickly become modified and we shall observe the appearance in this mass, but just now homogeneous, of small flakes of clay, which will slowly descend in the liquid and soon unite at the bottom of the vessel, leaving above them water that is nearly limpid. Clay is therefore capable of assuming two very different states: Now it is miscible with water, passes through filters, and allows itself to be carried along, and now, on the contrary, it is stable, does not mix with water, remains upon the filter, and allows limpid water to flow beneath it.

Pure water mixes with clay, and water charged with salts coagulates and precipitates it; hence the limpidity of sea water and the production of deltas at the mouths of all the great rivers, which deposit the clay that they have carried along as soon as their water becomes brackish.

So long as the earth contains dissolved salts of lime, its coagulated clay resists the action of rain and it is permeable, but if a persistent rain removes such salts, the clay allows itself to be carried along, the interstices through which the water and air circulated become clogged, and the earth becomes impermeable.

We are made aware of such impermeability by the persistence of the water in all the sloping portions. In winter, if the water remains in the furrows, the earth is impermeable. The remedy is easily pointed out. It is necessary to lime or marl the soil, and, of marling, one of the advantages, among many others brought to light by the experiments that we have just described, is precisely that of preserving the earth permeable to water and air.—P. P. Deherain, of the Institute, in La Nature.

The Mineral Production of Canada.

The annual preliminary statistical table of the mineral production of Canada, prepared by the Division of Mineral Statistics and Mines of the Canadian Geological Survey, has just been published, says the Iron Age. It shows the value of the total production in 1895 of minerals, both metallic and non-metallic, at $22,500,000, of which $6,370,146 was metallic and $15,875,197 was non-metallic, with $254,657 as the estimated value of mineral products not returned. The total production in 1894 was $20,900,000; that in 1893, $19,250,000; that in 1892, $19,500,000; that in 1891, $20,500,000; that in 1890, $18,000,000; that in 1889, $14,500,000; that in 1888, $13,500,000; that in 1887, $12,500,000; and that in 1886, $12,000,000. From this last it will be seen that the production of last year was the largest in any one year during the past decade, and that there was an increase of $10,500,000 from 1886 to 1896. The metallic productions last year consisted of copper of the value $949,229; gold, $1,910,921, iron ore, $238,070; lead, fine in ore, etc., $749,966; mercury, $2,343; nickel, fine in ore, etc., $1,360,984; and silver, fine in ore, etc., $1,158,633. The non-metallic productions were: Asbestos, $368,175; baryta, $168; chromite, $41,301; coal, $7,774,178; coke, $143,047; fire clay, $3,492; graphite, $6,150; grindstones, $31,532; gypsum, $202,608; limestone for flux, $32,916; manganese ore, $8,464; mica, $65,000; ochers, $14,600; mineral water, $111,048; moulding sand, $13,530; natural gas, $423,032; petroleum, $1,201,184; phosphate, apatite, $9,565; precious stones, $1,650; pyrites, $102,594; salt, $180,417; soapstone, $2,138. The production of last year exceeded that of the highest amount in any previous year by $2,000,000, the highest amount in any previous year being $20,500,000, which was reached in 1891. It is expected that the returns for the current year will show a still further increase, as the development of the mineral resources of British Columbia is exhibiting great progress.

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RECENTLY PATENTED INVENTIONS.

Mechanical.

OUTLET AND CUT-OFF FOR IRRIGATING FLUMES.—Daniel W. Willard, Redlands, California. This invention relates to devices for controlling the outlet of flumes employed for irrigating purposes. It consists of a hollow plug in the form of a metallic shell, the inner end of which is closed; this closed end being integral with the shell. The plug is constructed to have a sliding movement to bring the orifice within the flume for the outlet of water, or without the interior of the flume for closing the said outlet or regulating the same. The plug has a rotary movement, serving to present the orifice upstream or down-stream as may be desired. The device is durable and can be produced at a price to warrant its use in large quantities.

VEHICLE ROAD SCRAPER.—William F. Smith, Marquez, Texas This invention relates to a device for removing dirt from the peripheries of vehicle wheels while the vehicle is in motion. It consists of supporting arms, each secured at their forward ends to the reach and extending rearward and diagonally outward beyond the axle, clips carried by the said arms embracing the axle, the rear ends of said arms beyond the axle being bent parallel to the plane in which the wheel rotates, and provided with clamping boxes and scraper devices to embrace the wheel tire, these scraper devices being vertically adjustable in the clamping boxes of the supporting arms.

UMBRELLA ATTACHMENT FOR BICYCLES.—Effie M. Battenberg, Decatur, Indiana. This improvement provides a means for conveniently attaching an umbrella to a bicycle in a hoisted position, so as to afford protection to the rider against the rain and sun, and still leave the hand of the rider free to guide the bicycle or for other use. It is so arranged that its angle may be quickly and conveniently changed in a direction to the front or rear or to either side. It comprises a main frame having a relatively large ball and socket joint, a smaller ball and socket joint arranged concentrically to the first, and forming therewith double spherical bearings and means for attaching this joint to the bicycle and means for holding the umbrella staff.

WIRE STRIPPING TOOL.—William McMurtrie, West Superior, Wis. The invention relates to improvements in tools for stripping insulation from wires, and the object of the invention is to provide a tool by means of which the insulating material on a wire may be stripped either from the ends of the wire or from any desired part thereof, and also to produce a tool which is adapted to split the insulation longitudinally to facilitate its easy removal, and is also adapted to cut the insulation transversely, so as to determine the length of the wire to be stripped. It comprises handles pivoted together and terminating in jaws, a peripherally grooved bearing wheel mounted to rotate on the side of one of the jaws and laterally of the adjacent side of the handles, and a cutter disk mounted to rotate on the side of the other of said jaws and laterally of the adjacent side of the handles, whereby the tool may be drawn lengthwise of a long stretch of wire.

Railway Appliances.

TRUCK BEARING.—Stephen A. Eisele, San Antonio, Fla. The object of this invention is to provide a bearing, the lower or oil-containing section of which may be readily slid out of slideways in the upper section to receive a supply of oil even though the trucks are under heavy timbers, as would be the case in sawmills, also to form an inclined or wedge-like joint between the two sections of the bearing, so that when slid in the lower or oil cup section it will be raised up close to the axle. In brief, it comprises an upper section and a separable lower section, wedge-like interlocking portions being extended in the direction of the length of the said section, whereby they may be held together.

RAIL JOINT.—Thomas Poley, Brooklyn, N. Y. In this rail joint, the end of one rail is provided at its upper and lower portions with centrally arranged recesses, while the upper and lower portions of the end of the other rails are provided with centrally arranged lugs projecting therefrom and arranged to enter the said recesses. The lugs and recesses have their adjacent faces inclined in opposite directions.

Electrical.

DISTRICT TELEGRAPH CALL BOX.—William H. Garven, Portland, Oregon. This invention is in the nature of a district telegraph call box designed to indicate by a visual pictorial representation the thing called for, and provided with means for an answer in return from the central office indicating that the call has received attention. In brief the call box has a rotary circuit breaker having an actuating handle and tension spring, a rotary disk having a circular series of representations of the call and gearing connecting the disk to the actuating mechanism to the circuit breaker for causing the setting of the circuit breaker to impart an equal or commensurate throw to the disk.

Agricultural.

CHURN.—Henry Obermeyer, Beatrice, Neb. The object of this improvement is to provide a churn wherein a vertically reciprocating dash will be employed, the dash being provided with valves closing at their down stroke. The further object of the invention is to provide within the churn an agitating compartment from which the liquid will be forced, by means of which the butter when it is made will be assembled upon the upper face of the dash, thereby enabling it to be readily removed.

Miscellaneous.

BUNG.—Gerhard Zeilstra, Grand Rapids, Mich. This is a new and improved bung, arranged for convenient insertion in and removal from a barrel or like vessel, and adapted to be securely locked in place to prevent leakage of the liquid or gases contained in the barrel or other vessel. The bung is provided with a fastening device, provided with a spring-yielding arm adapted to be spread and engage the inside of a barrel at the sides of the bung hole, and a cam lever for actuating the arms.

CAKE PAN.—Marie Louise Perrottet, New York City. This invention relates to that class of cake pans which are constructed in sections, the sections being adapted to be united during the process of baking or to be separated in order to facilitate the removal of the cake. The pan is so constructed that the bottom will be an integral portion of one of the sections, the opposing section being grooved or channeled to receive the bottom, and provided with a flange or ledge adapted to extend beneath the bottom and be brought in close contact therewith, in order to prevent leakage at that point where the bottom connects with the removable section.

PICTURE FRAME.—Jacob A. Booher, Pittsburg, Pa. The invention relates to a glass picture frame, and the object of the invention is to provide such a frame in the form of a glass plate with a picture-receiving recess or pocket between its opposite faces and having an opening at one edge of the frame for the insertion of the pictures, which will be placed back to back therein, so that a picture will be exposed at each face of the frame through the transparent glass.

WOVEN CHENILLE FABRIC.—Leedham Binns, of Philadelphia, Pa. The object of this invention is to provide a new and improved chenille fabric of a highly ornamental appearance and so woven that when the wefts are cut in the usual manner the radiating fabric portions formed thereby will be of different lengths, thus producing a novel effect. The invention consists principally of a central web and sets of warps arranged in clusters in such a manner that one set contains a different number of warp threads from other sets, either of the same cluster or of different clusters, the warp threads being bound in place by wefts connected with the central web, the ends of the wefts projecting from the outermost warp threads to form tufts.

BOTTLE AND STOPPER.—Robert Temple, Denver, Col. This invention relates to so-called safety bottles for preventing the possibility of fraudulently refilling the same. It consists of a seal with an elastic and unbroken central section sandwiched between two inelastic sections, independent means for attaching the inelastic sections to the elastic central section and a weighted plate interposed between one of the inelastic sections and the inelastic central section and combined by the said parts.

WINDOW OR BUGGY WASHER.—Charles C. Bridwell, Portsmouth, Ohio. The object of this invention is to provide a means of holding a sponge in close relation to a water-supplying nozzle, also a more effective window-rubbing strip. A rigid tube serves as a handle and also for conducting water for washing. This tube is provided with a peculiarly constructed valve by which the flow of water is regulated and also with improved devices for attaching thereto a sponge and window-rubbing strip. The chisel or scraper for removing the mud is also attached.

ADVERTISING DEVICE.—Isidor Roecher, Memphis, Tenn. This invention relates to an improvement in signs and has for its object the production of an attractive sign which will simulate a human or animal head. It is so constructed that the eyes and tongue may be connected at the back and pivotally connected with the head in order that movement may be imparted to the said parts during the travel of the vehicle from the motion given to the body of the vehicle, due to the springs and the passage of the wheels over tracks or roadways.

Designs.

DESIGN FOR AN ANTIRATTLER.—Seth H. Morton, Lake Ann, Mich. The leading feature of this design consists of a T shaped body, the head of the body having vertically depending ends and the shank being curved vertically and return bent, the lower end being out of the plane of the head. Another feature of the design consists in the form of the returned portion of the shank, the same having a compound curve and terminating in a forwardly inclined part of the upper end.

DESIGN FOR A HINGE.—Albert Wanner, Jr., Hoboken, New Jersey. The leading feature of this design consists in the hinge having ornamental work along the face of the hinge and disposed at an angle thereto. Another feature of the design is a depending elongated ornament adjacent to the meeting ends of the hinge members.

DESIGN FOR A VAPORIZER.—John S. Judge, of Peterborough, Canada. The leading feature of the design resides in the tapering body having longitudinal corrugations therein, and having a rounding lever end. Another feature of the design is the plain upper end of the body capped by a convex top with a curved elongated member departing from the center of the said top.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

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This book, with its illustrations of typical libraries in the State of New Hampshire and notes on their progress, and the valuable table of statistics in the State of New Hampshire will be of very considerable value to modern librarians and can be warmly recommended to the presidents and directors of libraries everywhere.

SUNDELL'S SYSTEM OF PHILOSOPHY. Essays and speeches. By Albert F. O. Sundell. Shelby, Michigan: The Oceana Herald Print. 1895. Pp. 106.

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(6872) H. S. G. says: Will you kindly give me in your Notes and Queries a simple receipt, such as I can use at home without special apparatus, for "padding" sheets of paper into tablets? A. The composition is said to be prepared as follows: Glue, 4 pounds; glycerine, 2 pounds; linseed oil, ½ pound; sugar, ¼ pound; aniline dyes, q. s. to color. The glue is softened by soaking it in a little cold water, then dissolved together with the sugar in the glycerine, by aid of heat over a water bath. To this the dyes are added, after which the oil is well stirred in. It is used hot. Another composition of a somewhat similar nature is prepared as follows: Glue, 1 pound; glycerine, 4 ounces; glucose sirup, about 2 tablespoonfuls; tannin, one-tenth ounce. Give the compositions an hour or more in which to dry or set before cutting or handling the pads.

(6873) W. S. says: Will you kindly inform me in the SCIENTIFIC AMERICAN how the carpet soap is made which is used for cleaning carpets, woolens, silks, etc., or refer me to any book giving the desired information? A. Take 22 pounds of the best white soap and reduce it to thin shavings. Place it in a boiler, together with water, 8·8 pounds oxgall, 18·25 pounds. Cover up and allow to remain at rest all night. In the morning heat up gently and regulate it so that the soap may dissolve without stirring. When the whole is homogeneous and flows smoothly, part of the water having been vaporized, add turpentine, 0·55 pound; benzine, best clear, 0·44 pound; and mix well. While still in the state of fusion color with green ultramarine and ammonia, pour into moulds and stand for a few days before using. The product will be found to act admirably, and the yield is very good indeed.

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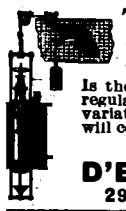

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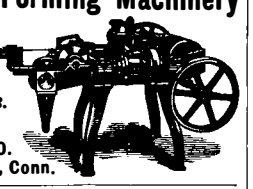

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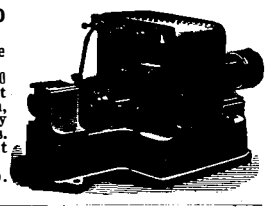

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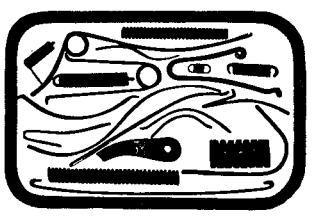

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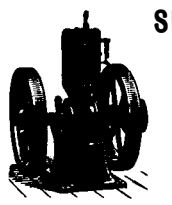

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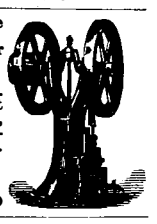

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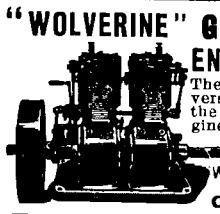

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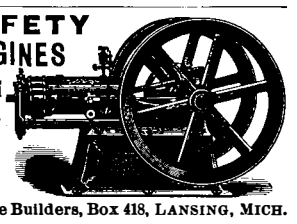

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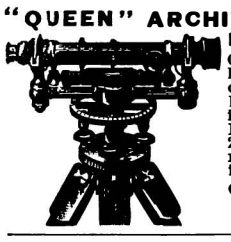

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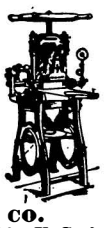

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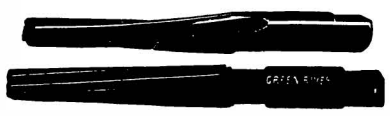

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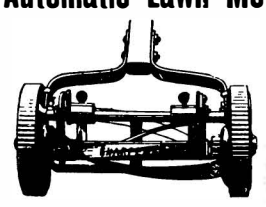

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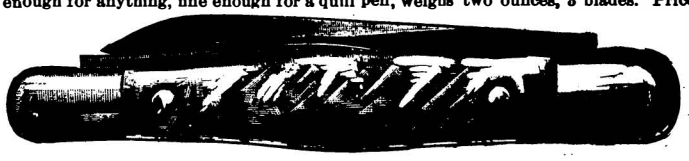

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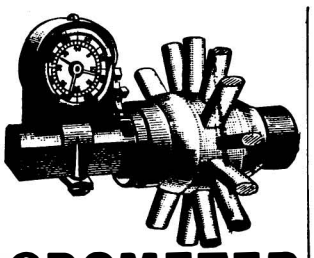

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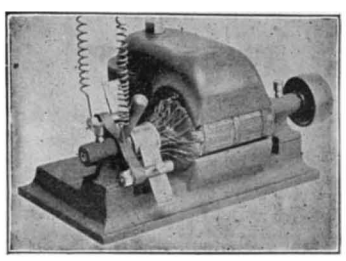

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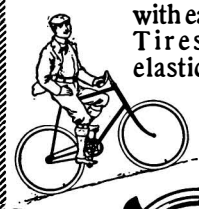

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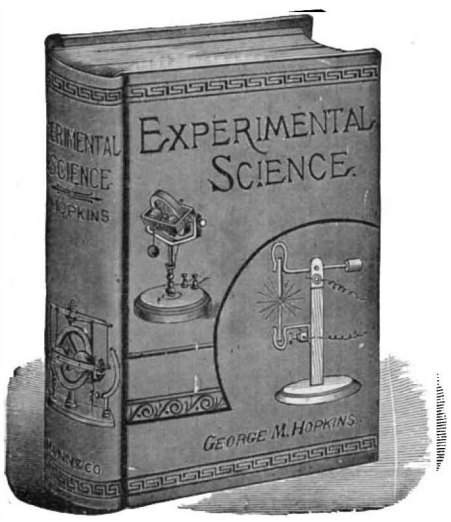

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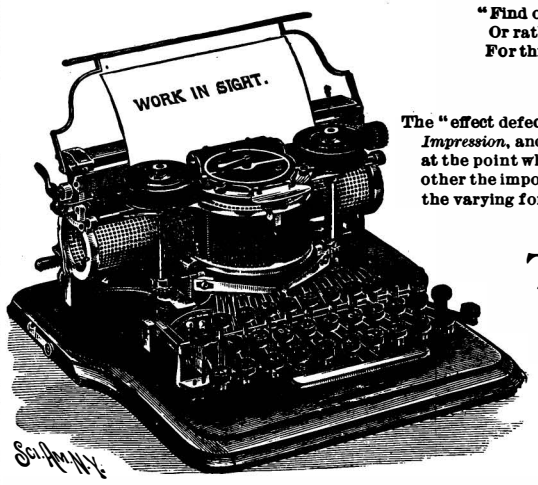

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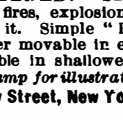

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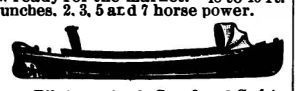

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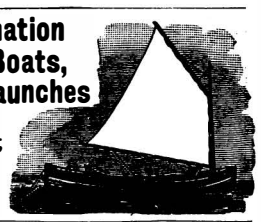

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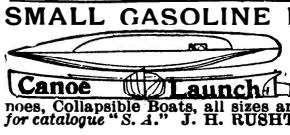

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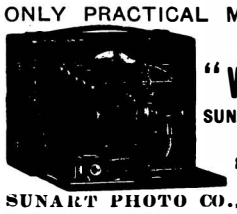

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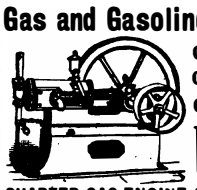

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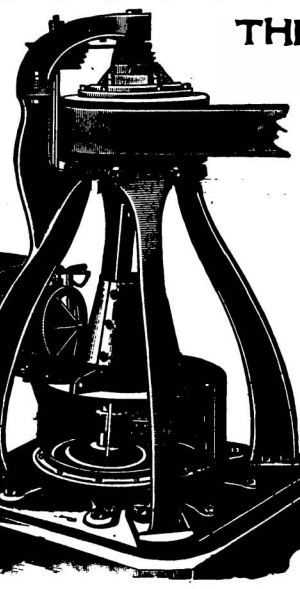

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